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Form Blindness Testing: Assessing the Ability to Perform Latent Print Examination by Traditional Versus Nontraditional Students

Dean James Bertram
University of Southern Mississippi

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FORM BLINDNESS TESTING: ASSESSING THE ABILITY TO PERFORM LATENT PRINT EXAMINATION BY TRADITIONAL VERSUS NONTRADITIONAL STUDENTS

by

Dean James Bertram

Abstract of a Dissertation
Submitted to the Graduate Studies Office
of The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

May 2009

ABSTRACT

FORM BLINDNESS TESTING: ASSESSING THE ABILITY TO PERFORM LATENT PRINT EXAMINATION BY TRADITIONAL VERSUS NONTRADITIONAL STUDENTS

by Dean James Bertram

May 2009

This study examined form blindness testing as a predictor of latent print examination success among traditional and nontraditional college students. A correlational analysis of traditional versus nontraditional students was also assessed. Data were collected for two groups: trained and untrained. The untrained group (n = 167) consisted of students enrolled in courses within the field of forensic science at a university in the southeastern United States during the spring 2009 academic term. Students retained within the untrained group were those with no fingerprint training. The trained group (n = 160) consisted of students who completed a science of fingerprinting course during the years 2003 to 2007 (archival data).

The researcher employed a correlational design to determine whether form-blindness testing significantly predicts ability to perform latent print examination tasks. The study examined whether age, GPA, traditional/ nontraditional status, corrective vision, science background, form blindness, and fingerprint training affects one's ability to compare and identify latent prints. Alpha was set at 0.05.

Regression analysis strongly supports the premise that a weighted set of variables significantly predicts the performance of college students on the fingerprint comparison test, with nearly two-thirds of the variance explained. Regression analysis also supports that a weighted set of variables significantly predict the performance of traditional college students on the fingerprint comparison test, with almost two-thirds of the variance explained. Moreover, findings suggest that a weighted set of variables also significantly predict the performance of nontraditional college students on the fingerprint comparison test, with more than two-thirds of the variance explained.

All three regression models confirmed that latent fingerprint comparison scores can be reliably predicted through knowledge of a weighted set of variables. The full model for all college students indicated that traditional or nontraditional status does not significantly contribute to understanding latent fingerprint comparison performance. All models rejected the importance of GPA and the use of corrected vision when predicting latent fingerprint comparison.

The most important predictors of latent fingerprint comparison performance, regardless of age grouping, were pattern recognition and form blindness. Regression findings demonstrate that the skills required for successful fingerprint comparison careers are highly dependent on one's ability to recognize patterns and forms.

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Approved:

[redacted]

May 2009

DEDICATION

This dissertation is dedicated to my wife Jennifer and our two daughters Stella and Lillie, who offered plenty of encouragement and many smiles during this process.

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LIST OF ABBREVIATIONS

AAFS	American Academy of Forensic Sciences
ADA	Americans with Disabilities Act of 1990
ADD	Attention Deficit Disorder
B	Regression coefficient. A measure of how much an independent variable influences the dependent variable. B is measured in original units to the data.
Beta	Standardized regression coefficient. A measure of how much an independent variable influences the dependent variable. Beta is measured in standard deviation (SD) units; viewed as the contribution strength of a variable.
CLPE	Certified Latent Print Examiner – certified through the International Association for Identification
ERIC	Education Resources Information Center
F	Fisher's Statistic. Ratio of the amount of variance explained by the model to the amount of variance explained by error.
FB	Form Blindness Scale
FBI	Federal Bureau of Investigation
FPL	Forced-choice Preferential Looking
GPA	Grade Point Average
IAI	The International Association for Identification
IRB	Institutional Review Board
JSTOR	Journal Storage, www.jstor.org

LSU	Louisiana State University
MAX	Maximum number or score observed
MIN	Minimum number or score observed
NFSTC	National Forensic Science Training Center
P	Probability of error
PR	Pattern Recognition Test
R^2	Ratio of the amount of variability explained by a regression model to the amount of variability explained by the model and error combined.
SAT	SAT Reasoning Test, Scholastic Aptitude Test, or Scholastic Assessment Test
SD	Standard Deviation, variability of the variable
SE	Standard Error, variability of the estimate
Sig.	Significance. Probability of error is within an acceptable level of error.
SWGFAST	Scientific Working Group on Friction Ridge Analysis, Study and Technology
VEP	Visual Evoked Potential

CHAPTER I

INTRODUCTION

The certification process for latent fingerprint examiners is a long and strenuous journey totaling more than 2,000 hours of education and training. As such, adult learners must hurdle several obstacles to become eligible for latent fingerprint examiner training. According to the Scientific Working Group on Friction Ridge Analysis, Study and Technology (SWGFAST, 2004), a latent fingerprint examiner first and foremost must possess "good moral character, high integrity, good repute … and high ethical and professional standing" ("*Latent print*," n.d.). Assuming one appears to possess such moral qualities, attention then turns to satisfying the extensive academic and technical requirements expected of those aspiring to be a certified latent fingerprint examiner.

With regard to training, latent fingerprint examiners must acquire a minimum seven years of professional work experience prior to certification application. It must be kept in mind that college education can be used to trim some required experience, with associate and bachelor's degrees permitted to substitute for two and four years' experience respectively. Additionally, SWGFAST (2004) reports that latent fingerprint examiners must satisfactorily complete at least 84 hours of formal training in latent print analysis, to include 1) written examinations covering both technical and developmental components of the science of fingerprint identification, 2) pattern recognition of inked fingerprints, 3) comparison of latent prints to inked prints, and 4) oral board tests and presentations of case work and/or courtroom testimony. Upon completion of the approved training, a trainee must then petition The International Association for Identification (IAI) for permission to take the Certified Latent Print Examination ("*Latent print*," n.d.).

Founded in 1915, the IAI is the oldest and largest forensic science professional working group in the world, encompassing more than 42 divisions internationally. In 1977, the IAI established the first certified program for the field of latent prints ("*IAI History*," 2007). To pass certification standards, an individual must correctly compare latent and inked prints with zero erroneous identifications, and score 90% on all written questions and 80% on pattern recognition ("*Latent print*," n.d.). While these guidelines are IAI specific, the Federal Bureau of Investigation (FBI) is the only other certifying body – and they too adhere to similar requirements ("*Federal Bureau.*" n.d.).

Although the IAI, SWGFAST, and FBI have lengthy guidelines, there is no mention of an individual being disqualified because of a deficiency pertaining to physical ability, visual acuity, form blindness, or form perception. Byrd and Bertram's (2003) national survey revealed that over 50% of crime laboratories use visual screening, be it form blindness, pattern recognition, or vision. Byrd and Bertram further explain that most agencies' concerns regarding form blindness testing revolve around the fact that no research has yet to validate the accuracy or reliability of the testing procedures.

Form blindness is "the inability to see minute differences in form regarding shapes, curves, angles and size" (Triplett, 2008). An analogy in the realm of sound would be not hearing a specific pitch until it reaches a certain volume. The same is true of vision, where minute dissimilarities in size, shape, or form cannot be seen until differences are magnified to a level within an observer's comprehension. Problems in comparison training not only result from a failure to see external things, but also a failure to recognize differences and similarities, and to understand and interpret them when seen.

One problem for the adult learner is that actual competence of latent print comparison is not measured until well into training modules (IAI, 2008). It is feasible, then, that a person may not realize they lack the capacity for latent print examination until comparison exercises commence – which could be a time period of more than six years if the student started the career path at a university in a forensic science program.

Statement of the Problem

Does form blindness testing significantly predict one's ability to perform tasks needed in latent print examination? Furthermore, does traditional and nontraditional student status, participation in fingerprint training courses, age, grade point average (GPA), vision (corrected/non-corrected), or academic major (science/non-science) of prospective latent print examiner trainees have a quantifiable effect on their ability to compare and identify latent prints?

Purpose of the Study

The broad purpose of this study is to identify a set of predictor variables that account for the most variance in one's abilities to perform the tasks needed to compare and identify latent prints. The specific purposes of this study include:

1. To determine if there is a significant relationship between the criterion variable latent fingerprint comparison score and the best-weighted set of predictor variables from among form blindness scale, latent fingerprint training course, fingerprint pattern recognition score, corrected vision, grade point average, age, and the interaction of form blindness scale and fingerprint pattern recognition test.
2. To determine if there is a significant relationship between the criterion variable latent fingerprint comparison score and the best-weighted set of predictor variables for nontraditional college students among form blindness scale, latent fingerprint training course, fingerprint comparison score, corrected vision, grade point average, the interaction of form blindness scale and fingerprint pattern recognition test, and academic major (science/non-science).
3. To determine if there is a significant relationship between the criterion variable latent fingerprint comparison score and the best-weighted set of predictor variables for traditional college students among form blindness scale, latent fingerprint training course, fingerprint comparison score, corrected vision, grade point average, the interaction of form blindness scale and fingerprint pattern recognition test, and academic major (science/non-science).

Hypotheses

The hypotheses of this study are as follows:

1. There is a significant relationship between the criterion variable latent fingerprint comparison test and the best-weighted set of predictor variables from among form blindness scale, fingerprint pattern recognition test, corrected vision, grade point average, academic major (science/non-science), age, the interaction of form blindness scale and fingerprint pattern recognition test, and a latent fingerprint training course.
2. There is a significant relationship between the criterion variable latent fingerprint comparison test and the best-weighted set of predictor variables for traditional college students among form blindness scale, fingerprint pattern recognition test, corrected vision, grade point average, academic major (science/non-science), the interaction of form blindness scale and fingerprint pattern recognition test, and a latent fingerprint training course.
3. There is a significant relationship between the criterion variable latent fingerprint comparison test and the best-weighted set of predictor variables for nontraditional college students among form blindness scale, fingerprint pattern recognition test, corrected vision, grade point average, academic major (science/non-science), the interaction of form blindness scale and fingerprint pattern recognition test, and a latent fingerprint training course.

Delimitations

The study is delimited to the following aspects:

1. The study is limited to students at a university in the southeastern United States.
2. The study is limited to students with no prior fingerprinting experience.
3. The trained group is limited to students enrolled within an introductory fingerprinting course at a university in the southeastern United States.
4. The untrained group is limited to students enrolled in coursework within the academic fields of Administration of Justice or Forensic Science but with no latent fingerprint training.

Assumptions

The assumptions of this study are as follows:

1. The retrieved archival data from the experimental group was collected in a valid and reliable manner.
2. Participants in this study exercised a high degree of effort on all tests.

Definition of Terms

Terms as used in this study are defined as follows:

Adult Learner. Learner that has reached the age of 24 years, or has gained full-time employment within the field of forensic science.

Certified. Endorsement by an influential organization stating you have met certain requirements and are officially recognized as being qualified in a particular field.

Corrective (Corrected) Vision. Visual impairment corrected by standard lenses, contact lenses, or other self reported form of visual aid.

Fingerprint Pattern Recognition Test. Instrument used to measure an individual's ability to group fingerprint patterns together.

Form Blindness. "The inability to see minute differences in form regarding shapes, curves, angles and size" (Triplett, 2008).

Form Blindness Scale. Instrument to measure an individual's degree of form blindness on a scale from 0-100.

Form Perception. Ability to see minute differences in angles, forms, and size. Form perception or recognition takes place in the visual cortex of the brain, not the eye.

Grade Point Average (GPA). Average grade earned by a student on a four-point scale, figured by dividing the grade points earned by the number of credits attempted.

Latent Fingerprint Examination. Instrument used to measure competency on comparing latent prints.

Latent Fingerprint Trainee. Individual hired by a forensic science agency to study the science of fingerprints but has not qualified as an expert.

Latent Print. Transferred impression of friction ridge detail not readily visible; generic term used for questioned friction ridge detail.

Memory. Process of storing and retrieving information in the brain.

Nontraditional Student. Student who is 24 years of age or older when admitted to the university or community college.

<u>Pattern Recognition.</u> Ability of an individual to visually recognize shapes, lines, contours, angles, edges, and curvatures.

<u>Radial Loop (Right Slope Loop).</u> Type of pattern in which one or more ridges enter upon either side, recurve, touch or pass an imaginary line between the delta and core and pass out, or tend to pass out, on the same side the ridges entered. The flow of the pattern runs in the direction of the radius bone of the forearm (toward the thumb). ("*SWGFAST Glossary*," 2003, p. 14)

<u>Science Major.</u> Student majoring in a science within a university in the southeastern United States; Administration of Justice majors are excluded for the purpose of this study.

<u>Trained Group.</u> Students enrolled within an introductory fingerprinting course.

<u>Untrained Group.</u> Students enrolled in coursework within the academic fields of Administration of Justice or Forensic Science but with no latent fingerprint training.

<u>Visual Acuity.</u> Acuteness or clearness of vision, especially form vision, which is dependent on the sharpness of retinal focus within the eye and the sensitivity of the interpretative faculty of the brain (Cline, Hofstetter, & Griffin, 1997).

<u>Visual Perception.</u> Ability to attain and interpret information from visible light entering the eyes.

<u>Vision.</u> Processing and perception of an image as seen by the eye (Hole, 1987)

Justification of Study

In the profession of latent print analysis, form blindness has been widely ignored for the last century. As we move more deeply into the 21st century, however, the fingerprinting discipline is finally becoming aware of the problem (Wertheim, 1996). Questioned document examiners have recognized for years, dating back to 1910, the need for screening potential trainees for this visual condition. One of the most recognized and highly respected certified latent print examiners in the field, Pat Wertheim claims that "a job requiring a high degree of visual acuity will be extremely frustrating for a person who is form blind, and that person can never become fully competent" (pp. 154-155). Wertheim (p. 158) goes on to boldly state that "training and experience alone do not make a good latent print examiner – never have and never will!" The problem and justification for this study – although form blindness is acknowledged in the literature – is that little effort has been expended by researchers within the field of latent print analysis to quantify their beliefs. Hypothetically, if an applicant is screened and found to be form blind, then they may be excluded from being a trainee. The question is: How does one know if a trainee could or could not have completed the training course if they were, in fact, form blind?

Other research also has examined the relationship between age and vision for latent print examiners. Byford (1987) focused on psychological attributes, vision and eyesight tests, seeking to determine whether aptitude and eyesight tests assist in the evaluation of potential recruits and contribute to the professional standards of latent print examiners. The eyesight test measured visual acuity and contrast threshold, while the psychological test primarily measured logical thought processes. Utilizing eyesight tests, Byford (1987) found that older fingerprint examiners were more likely than younger examiners to be referred to optometrists, but in many cases still outperformed their younger counterparts when comparing fingerprints. These results provide insight into the effect training has on the maintenance of visual skills. Byford concedes, though, that more research is needed to test the visual acuity of latent print examiners.

It is the desire of this researcher that the results of this study be used to enhance the latent print profession through assessing and predicting one's ability to complete a latent print comparison final examination, taking into consideration visual acuity, pattern recognition, form blindness, age, GPA, participation in latent print training, and science background.

CHAPTER II

REVIEW OF RELATED LITERATURE

Dating back to the early 1900s, much has been written on the science of fingerprinting (Federal Bureau of Investigation, 1984). Yet even though nearly 100 years have passed since the first FBI section was established in 1924, much debate continues regarding the qualities needed to become a good latent fingerprint examiner. For example: Are traditional students more suited than nontraditional students for latent fingerprint examination? Is age a factor in predicting success? Is vision the key ingredient, or is perception of form more important? Is one's college major (science versus nonscience) a predictor of success? Does college grade point average serve as a gauge for field performance? The following review of related literature will examine these and other issues purported to be associated with predicting success as a latent fingerprint examiner.

Even though there is a multitude of information regarding the above-referenced variables on a generic level, few of the variables are referenced specifically to latent print analysis. This is not at all surprising, however, given that the field of forensic science has been slow to promote self examination. One major reason for the lack of such studies is that the field is relatively new among academics, and has historically been an applied science with forensic scientists spending the majority of their time working backlogged cases in lieu of self analysis. This is the main contributing factor for researching this specific topic.

All variables in this study were explored within the context of comparing traditional and nontraditional students on the dependent variable form blindness. The databases utilized for the search of literature pertaining to this topic include: ERIC, E-journal Search, Google Scholar, Government Documents, and JSTOR. The information was divided into the following subheadings: Theoretical Framework of Visual Perception, Brief Timeline of Form Blindness, Form Blindness: Mapping the Visual Pathway, Medical Profession and Form Blindness, Form Perception Tests, Corrective Versus Non-Corrective Vision, Use of Grade Point Average in Predicting Workplace Success, Predicting Workplace and Academic Success of Traditional and Nontraditional College Students, Science Majors Versus Nonscience Majors as Predictors of Success, and a Summary.

Theoretical Framework of Visual Perception

Individual perception is highly dependent on numerous variables. Though common aspects to the anatomy and physiology of vision exist, many other factors also contribute to vision. Minute differences in the anatomy and physiology of living beings exist, but the primary issue for vision is perception. Perception of shapes, objects and sizes may vary from one individual to another by differing angles of view, lighting, experiences, and frame of mind. As writers often have difficulty editing their own work because they read what the brain believes was written, perception also may be skewed when the brain perceives what may be no more than a prevalent thought. In this regard, criminalistics have long questioned the accuracy of eye-witness accounts (Cutler & Penrod, 1995; Morgan, Hazlett, Dóran, Garrett, Hoyt, Thomas, Baranoski, & Southwick, 2004).

Perception, thus, is a mental function which compiles sensory input and thought. Given this, concepts of delusion, illusion, and misunderstanding have developed. Most individuals, having experienced an illusion of water across a hot dry paved road or other common illusion recognize the existence of these issues. The basis for illusion, delusion, or misunderstanding is not at this time fully understood, nor will it be fully addressed in this work; however the general concept of the existence of these visual issues is accepted.

This document addresses various scientific theories which relate to how people learn to see rather than focusing on concepts of delusion, illusion, and misunderstanding. Theories of the ancient Greeks through Gestalt theory and computational theories will be considered. This theoretical framework allows the researcher to consider visual perception as a function of scientific, psychological and perceptional variables. Of all theories considered, the greatest emphasis will be placed upon the theory of Gestalt. Though one may initially question utilization of Gestalt theory in a study of visual perception, close consideration eventually aids with understanding the importance of including this theory which draws heavily upon feelings and beliefs. Though the science of vision (i.e. anatomy and physiology of sight) is the issue, psychological factors are equally as important as they affect what the mind interprets as sight, which is what we call perception.

When two individuals observe an object described in scientific terms, the likelihood that perception will yield the same description is in question. In other words "Is the glass half empty or half full?" Most individuals know associates who will, without fail, answer that question as "half full" while others opt to view the glass as "half empty." Clearly, some issues have coalesced within these people to develop these half-empty and half-full mentalities. As such, one can clearly see the potential effect of psychological input on perception. Hence, the importance of developing an understanding of scientific mechanisms, as well as psychological theories, is important to better understanding perception.

Greek Theories of Visual Perception

Two vastly differing views of perception proffered by the Greeks were intromission and extramission. Though each theory may seem considerably far fetched by today's standards, these theories were debated by the greatest minds of the day. The theory of intromission held that objects created "eidola" or resemblances of themselves, much like locusts shed their exoskeleton. These theorists, who include Democritus (c. 425 B.C.) and Epicurus (342-270 B.C.), believed that eidola, once created, were captured by the individual's eye. According to Gordon (1997), it was held that a person saw the shape created by entry of the eidola into the eye. Gordon also states that the Greeks believed that objects could be seen in the cornea of the observer as a mirror reflection. This approach, however, led to numerous unanswered questions regarding "eidola." These troubling questions, which included 1) passage of "eidola" through each other without distortion or interference, 2) the ability of "eidola" of large objects to enter the eye, and 3) the ability of "eidola" to enter numerous individuals simultaneously, were all issues that troubled Greek intromission theorists.

The opposing view to intromission, the theory of "extramission" was propagated by Plato (c. 427-347 B.C.) and held that sight was initiated from the viewer. This theory maintained that a visual "fire" emanated from a person's eye, forming a pathway that allowed "motions" of objects to pass into the "sensorium" (Gordon, 1997). Detractors of this theory, including Plato's student Aristotle (384-322 B.C.), questioned that rays from an eye were capable of reaching distant heavenly bodies. The Greek theories seemed relatively sensible given the knowledge and understanding of the day. However, advances in technology and science made the need for expanded understanding clear.

Even though Greek theories indicate that perception results from the placement of a copy of an object's image on the eye or brain, the theories are completely void of modern physics and optics concepts. The remnants of Greek theory remain, however, as the object image copy upon the eye or brain continues as a prominent factor in "template matching" theories.

Kepler and the Retinal Image

Modern vision theories are generally traced to the works of Kepler. His work, *Ad Vitellionem paralipomena* (1604), holds the first description of how the retinal image appears in the human eye (Lindberg, 1976). Lindberg also states that Kepler's explanation was initially confirmed through experimentation a short time later when Scheiner (1619) observed a retinal image in an eye by removing the sclera of an Ox. Scheiner then placed the lens into a hole in a shutter through which light was allowed to pass (as noted by Descartes, 1637). The resulting image was problematic in that the image projected onto the retina was inverted. Thus the question for theorists became: why is the view of the world not up-side down? Given the observations through experimentation, theorists concluded that the reason the world is not viewed upside down is that the retinal image is not the image actually observed. Kepler's pivotal work established his view of retinal imagery (Lindberg, 1976).

With a general acceptance of Kepler's retinal image established, numerous other questions again came to light. Clearly, images projected upon flat surfaces are two dimensional, thus the issue of proper perception of a three-dimensional image portrayed as two dimensional arises. Similarly, this retinal view indicates a miniscule projection size that might be considered a significant hindrance to accurate judgment of true size. Many other questions without clear and immediate answers arise as a result of Kepler's retinal image theory.

Perspective Ambiguities

Fifteenth century Italian artists/architects Brunelleschi and Alberti were greatly responsible for the development of the artistic field of perspective drawing. An artistic technique called "Leonardo's window" was designed to facilitate the understanding and nature of perspective and perspective drawing. This technique requires the artist to review a scene through a window from some fixed point, copying this view through the glass onto their media (Gordon, 1997). Exercises such as this tend to give rise to numerous possibilities of three dimensional scenes from a single two dimensional perspective. As stated by Gordon, this is a difficult concept for many to grasp as a general belief exists that vision is more definitive than this exercise shows.

In the 1940s, Albert Ames placed additional emphasis on this matter. The "Ames Chair" was an artistic demonstration that objects appear a particular way as a result of individual perception combined with perspective. Involving a large collection of rods and shapes in three-dimensional space, the objects appear as a chair from one perspective (but not others). Ames intended to highlight the ambiguity of visual sensory input to a single receptor. Ames' efforts emphasized the difficulty of understanding a three dimensional image from a single viewpoint (Gordon, 1997).

Perceptual Hypothesis

Herman von Helmholtz and Richard Gregory, early constructive theorists, held the position that perception of the world cannot be achieved directly because there is so much missing information regarding what is processed and displayed upon the retina (Bruce, Green, & Georgeson, 1996). Helmholtz believed that "unconscious inferences" (p.121) filled informational gaps about surroundings and the images processed by viewers. The necessity for individual interpretation of visual data is related to the indirect nature in which data is collected. For example, a person who has only seen pink flamingos may logically assume that flamingos of other colors do not exist. Scientific hypotheses are generally formulated in a similar manner (Gordon, 1997). Both Hemholtz and Gregory maintain that images are interpreted and perceived as a function of the components of an individual's knowledge base obtained through years of learning (Bruce et al.).

Advancing from earlier theories, Gregory espoused the belief that human perception results from a series of hypotheses created about the world (Gordon, 1997). This is evidenced by common visual illusions which are influenced by knowledge and expectation as in the following sentence: *Touhgh all the lrettes of tihs sntecne are sracblemd, a vrey hgih pcertnegae of rardees wlil raed tihs sntecne wouthit eincxerpenig snifiginact dicfiftiules as the barin psecorses tihs jblume of lrettes as a sntecne in cmomon lguangae.* This is illustrated in the dissertation work of Rawlinson (1976) in which research showed that randomization of middle letters in words has little effect on the cognition by the reader. Readers immediately recognize errors in spelling because the brain is conditioned through reading and expects the image to be sensible, thus most readers continue practically without slowing. Other illusions are attributed to erroneous assumptions (Kanisza's Triangle) and erroneous calibration (e.g. tilt illusion) (Bruce et al., 1996).

Ecological Approach

A new approach to visual processing, the "ecological approach," was proffered by James Gibson during the 1950s. Gibson insisted that all images required for full perception were available within the environment and readily perceived by active observers. Emphasis was placed on the presence of all visual cues necessary for perception as a part of the retinal image. In contrast to constructivist theorists who argue that size determination requires viewers to compare the retinal image with the distance from which it was viewed, Gibson held that a viewer will base a judgment of size on the amount of background the image covers. Direct perception theories, however, generally fail to provide explanations of the common visual illusion (Bruce et al., 1996).

Gestalt Theory

The Gestalt movement is most commonly associated with three individuals, including its founder Max Wertheim, and his younger counterparts Wolfgang Kohler and Kurt Koffka (Gordon, 2004). Of all the visual perception philosophies in the theoretical framework, Gestalt Theory best establishes the importance of this dissertation study on form blindness. According to Webster's Third New International Dictionary (Gove, 1976), the term Gestalt means shape or form. Gestalt psychology is the "study of perception and behavior from the standpoint of the organism's response to configurational wholes" (p. 952). The common everyday phrase that accompanies this theory is that the whole is greater than the sum of its parts. This theory negates any idea or philosophy which looks at a single stimulus. A simplistic example would be the face of a snowman. An individual does not see a carrot or two pieces of coal, but rather perceives the nose and eyes of a snowman.

It is not possible (nor the intent of this review) to cover all published research on the multiple theories surrounding the field of Gestalt. However, a review of selected literature pertaining to the overall purpose of this study is suitable. First, the Law of Similarity describes a belief that individuals attempt to perceptually partition objects into groups or visual categories such as color, shape, size, and orientation (Beck, 1966). This is important because fingerprints are categorized into shapes, patterns, sizes, and orientation by fingerprint examiners as part of everyday job obligations. For example, a trained examiner may attempt to first orient the fingerprint and then classify the print into a pattern group, such as the arch, loop, or whorl. The size of the fingerprint could possibly be used to determine if the print belongs to an adult, child, man, or woman. The Gestalt principle of similarity was used within this research through use of the pattern recognition test.

The second law of Gestalt Theory is the Law of Proximity, which claims that when two objects are in close proximity to one another, they may be assumed as one even when separate (Gordon, 2004; Kubovy & van den Berg, 2008). An example of this would be a man and woman waiting to be seated at a restaurant. Neither individual knows the other, but the hostess may assume, due to their proximity, that they are together and ask them if they would like to be seated together. This could be true for any two or more items that are perceived visually as close to one another.

A third Gestalt principle is the Law of Continuity, which claims that an individual may both visually and auditorily perceive something based on repetitiveness (Gordon, 2004). An example of this principle would be the blinking of a caution light (yellow) at an intersection. The intervals would be similar and there would be an assumption that the intervals were constant from learned experiences. The same would be true with sound. The best example of this may be the sound of an alarm clock beeping every morning at a specific time.

The Gestalt principle of closure states that the brain often fills in gaps of missing information that it does not truly receive through its senses to complete a figure of common knowledge to the viewer (Sternberg, 2003). A classic example is in the childhood game connect the dots. The researcher believes this could easily happen in the field of latent print examination. If a ridge stops and a ridge starts directly below or adjacent to the first ridge ending, the examiner could possibly close the missing space through misperception of a missing ridge in the latent print. This could void the comparison and have drastic ramifications to the examiner's career and the outcome of the judicial process.

Another important Gestalt theory, the principle of symmetry, states that humans collectively envision images that are symmetrical. To illustrate, Attneave (1955) used a game among participants similar to the game of battleship. Each participant drew a shape on graph paper while the opponent attempted to figure out the shape by calling out grid square numbers. The other participant answered the question with only a yes or no. The person that used fewer questions wins the game. Attneave discovered that symmetrical shapes were determined by winners at a much higher rate when the picture was symmetrical rather than asymmetrical shapes. A primitive example of the symmetrical portion of Gestalt Theory is that of a deer hunter who discovers a shed antler with only one side of the rack present. The rack is observed as having four points. The hunter would then assume that the rack is most likely symmetrical, giving the theory that the deer previously had an eight point rack.

The last Gestalt theory of interest to this project is the Law of Common Fate, which stipulates that when a group of objects move together, each object is in fact a portion of one whole unit (Sternberg, 2003). This is similar to the previously discussed Law of Proximity with the difference being the concept of motion. An example of common fate is a group of people wearing business suits exiting a subway train and walking in the same direction. One may assume that the group has a "common fate," maybe walking to work together. This theory shows that objects traveling in the same direction are often assumed to be one unit when they could instead be individuals not a part of a whole.

Computational Approach

The final theory regarding visual perception is the computational approach. Best demonstrated through the work of David Marr, computational psychologists create computer models of visual processes to understand those processes. Proponents of the computational approach hold that individuals who experienced difficulty in providing image descriptors may have vastly different perceptions. Also known as "inverse graphics," this process utilizes a starting point and creates a scene from that point. Bruce et al. (1996) note that a very realistic image may be created from a single starting point. The visual system is thus tasked with reversing that process and utilizing data projected upon the retina to determine the cause(s) of that scene. The aim of computational vision is to identify, through a mathematical process, how people perceive visual images and assign neural components functional roles in the identified process.

Modern Science: How do people learn to see?

The importance of understanding how individuals learn to see and comprehend visual sensory input must be emphasized. Logically, one should address this topic through the stages of growth development. A great deal of study has focused on the development of sight in infants. This body of work indicates that vision structures and pathways are not entirely functional at birth, and thus diminish infants' ability to focus on single objects. Hendrickson and Yuodelis (1984) identified three specific signs of measurable maturity in the vision system of an eight-day old infant. First, the formation of the foveal depression is not complete due to continued movement of ganglion cells and nuclei in the days following delivery. Second, retinal development remains in the very early stages as indicated by the prominence of Chievitz's transient layer. Finally, the development of photoreceptors is considered the best indicator of visual system maturity. In eight day old infants, though cones of limited development and number may be found, research indicates that children may reach an age of three to four years before development is complete. Understanding the development of both visual abilities and skills is important when developing an understanding of how humans learn to see.

Clearly, foveal development differs between adults and infants, but the relationship of visual acuity for infants is a simple comparison to older individuals. Researchers do question, however, how much these changes affect what is learned through visual sensory input as well as the actual role of anatomical change. Studies indicate that change in an infant's visual acuity is actually a result of changes taking place in the retina (Abramov, Gordon, Hendrickson, Hainline, Dobson & LaBossiere, 1982). This research indicates that infant sight, in the months following birth, has little to do with the fovea. Additionally, great discussion regarding the role of the visual cortex in newborn sight has occurred. Tests for visual cortex function in infants deal specifically with orientation and discrimination. This study shows that, in general, infants at six weeks of age are capable of differentiating between visual stimuli when only the orientation of the object and the infant have changed (Slater, Morison, & Somers, 1988).

Other works also indicate such abilities are in fact present at birth, implying at least a degree of functionality of the visual cortex from the point of birth. The fact that some newborns are capable of discrimination between objects based upon orientation appears to go beyond the abilities of subcortical mechanisms (Slater et al., 1988). As is the case with other development processes, there seems to be relatively clear developmental stages for visual perception. The earliest recognized stage occurs when the infant becomes capable of distinguishing visual features. A popular view holds that this discrimination is based more upon texture since the view of the infant relates patterns within their known spatial structure (Hartmann, Conte, & Purpura, 1996). The technique, measuring visual evoked potential (VEP) response, is designed to measure both infants' and adults' spatial processing abilities. VEP responses are considered ideal for evaluating development within the neural system as the methods used and stimuli employed are simple and act upon a wide range of specimens without danger of harm (Zemon, Hartmann, Gordon, & Prunte-Glowazki, 1997).

Utilization of such procedures aids in identifying vision disorders early in life, allowing for immediate action. There exist two problems when utilizing these techniques: subject's attention span and the actual response (rather than normal brain activity (Zemon et al., 1997). Differing techniques seemingly cause variation in VEP response. The responses – symmetric and anitsymmetric –

result from sensing similarities and differences between the textures respectively. It is the antisymmetric response that creates the most interest when obtained in an infant subject. This response is believed to include spatial interactions that are intracortical in nature. Hartmann et al. (1996) also noted that infants usually reached an age of 32 weeks before a statistically significant antisymmetric response occurred, suggesting that mechanisms mature at varying rates, and that cortical mechanisms are clearly not the first to mature.

Norcia, Tyler, Piecuch, Clyman and Grobstein (1987) expanded VEP research by studying a group of infants with special and regular developmental issues. The study of pre-term infants indicates there is a general acceleration of development compared to full-term infants. As visual development occurs in infants (both pre- and full-term), other developments are contingent upon sensory development. Moreover, this is the case for pre-term infants who are at risk for many problems that full-term infants are not. It thus becomes necessary and vital to understand healthy development sequences if one plans to recognize problems in the development of pre-term infants. Though VEPs are often utilized to study visual development, Forced-choice Preferential Looking (FPL) is another viable option (Norcia, et al.). An issue with the FPL is the amount of correction that should be allowed for the child's age versus the child's conceptual age – a concern also debated when the VEP test is utilized on pre-term infants.

Regardless of physical or conceptual age, it is accepted that the first six months of life is a period in which dramatic vision improvements occur). Roessler and Dannemiller (1996) hold it is during this time that one of the greatest developments occurs with respect to sensitivity and movement – because it conveys a tremendous amount of information to the viewer.

Finally, recognition of motion is a developmental visual trait that begins at a very early age. Possibly evolutionary in nature, as the recognition that motion has meaning (danger, food, etc.), very young infants tend to follow motion of persons and objects. Additional and extended study of motion sensitivity may be useful in developing an enhanced understanding of rates of maturity of visual cortical centers (Roessler & Dannemiller, 1996). Studies of visual discrimination and motion response among infants will continue to offer insight into vision and whether perceived sight is a function of anatomy or neurological systems of the brain. This understanding, once developed for infants, will be vital to developing a better understanding of perception for all people.

Conclusion

Many considerations exist when addressing individual perception. Anatomical, physiological, and psychological models all have developed support as factors of perception. It is undoubtedly true that visual structures and pathways grow and mature, but it is equally well demonstrated that environment and experience affect perception.

It is entirely possible that infants may be the only persons who see the world as it truly is. The irony of this is that humans who have an unskewed view of the world may be the only ones capable of communicating reality to others. Perception is a function of many factors: vision, environment, emotions and past experiences. Though perception of objects is a result of many factors, one must realize that those factors result from growth and learning, and will likely be maintained over time. Perception of vision will remain unchanged, however, without significant and life-changing events affecting one or more of the perception factors.

Brief Timeline of Form Blindness

The earliest reference to form blindness pertaining to forensic science emerges from the writing of Albert S. Osborn in 1929. Osborn published the first form blindness examination on record. Osborn's test focused on the perception of handwriting forms, and is still used today by experts in the field of questioned documents. According to his great-grandson J. Osborn (personal communication, August 11, 2008), A. Osborn was stirred to action by a judge who was unable to visualize the differences in evidentiary items submitted in a handwriting analysis case. This judge, in effect, was "form blind" but did not know it.

The test was then given to Professor Joseph Jastrow of the University of Wisconsin to establish if certain people indeed have difficulties visualizing minute differences in form. Professor Jastrow concluded there was great variation in the quality (or interpretive ability) of human vision (Osborn, 1929). In the *Journal of the American Institute of Criminal Law and Criminology*, Osborn (1939) once again mentions form blindness in an article focusing on shapes, curves, and angles. The test measured the ability of an individual to determine which shapes were perfect squares and triangles without the use of measuring devices. It also required test takers to rank circles from smallest to largest, and angles from least to greatest. Unlike the first test, this test focused on one's ability to see differences in angles and shapes, not a focus on minute details. Although Albert Osborn was an innovator regarding form blindness research, his study seemingly ended following the re-publication of his book in 1946. The next similar study would not arrive until some 41 years later.

A study by William Byford (1987) focused on psychological attributes, vision, and eyesight tests. Byford's research examined several variables to predict and evaluate an individual's ability to successfully complete a latent print training course. Byford looked briefly at age but concentrated more heavily on eyesight tests and psychological tests measuring intelligence and logical thought processes. Again, Byford concluded that visual acuity and psychological aspects are not the definitive answer to the selection of applicants for the job of latent print examination. This study stimulates debate and interest, while concurrently encouraging further research.

Form Blindness: Mapping the Visual Pathway

To better understand the topic of form blindness, two separate and distinct areas must be addressed. These areas are vision and memory. First, vision is the processing and perception of an image as seen by the eye (Hole, 1987). Vision is mainly concerned with the color, form, distance, and tri-dimensional extension of objects (Ballesteros, 1994). Essentially, when a person sees something, it is either giving off light, or light waves enter the eye through the cornea and pupil. At the same time, the iris expands or contracts to allow more or less light into the eye. These light waves are then presented to the lens, which adjusts itself to change the focal length. The light waves are then exposed to the vitreous humor and reflected onto the retina, which in turn projects an actual image upon the retina in an inverse position (and reversed from left to right). At the retina, light waves are transformed into electrical impulses, whereby true vision begins. This process involves the translation of an image from the eye to the visual cortex of the brain. The image is then routed from the retina to the fovea centralis (where the greatest visual acuity takes place), and is then passed on from the fovea to the optic nerves. These nerves give rise to the X-shaped optic chiasma, whereupon the nerves from the nasal half of the retina cross over (but the nerves from the temporal side do not). Thus, nerves from the nasal half of the left eye and the temporal half of the right eye form the right optic tract, and nerves from the nasal half of the right eye and the temporal half of the left form the left optic tract. At the end of the optic tract, the nerves are transmitted via optic radiations received in the visual cortex, which is located in the occipital lobe of the brain. The visual cortex secures the inverted image from the retina and reverses it back to its proper position (Zusne, 1970).

Within the visual cortex, the image is received by the striate cortex and the parastriate. The striate cortex receives visual impulses and transmits them into the immediately adjacent prestriate area, where predominant pattern recognition takes place. It appears that the striate cortex serves primarily for the perception of light and color, whereas the parastriate appears to function more on form perception (Cronly-Dillon, 1976; Leisman, 1976).

Psychologists have repeatedly attempted to identify exactly where form perception and pattern recognition occur through 1) monitoring lesions on different areas of the brain and 2) testing what function each area affected. The results concluded that form perception was affected, to some extent, by all areas of the brain where lesions occurred. The most important conclusion, however, is that some aspects of form perception in humans depend on brain areas other than the striate cortex and the parastriate (Leisman, 1976).

Memory is the process of storing and retrieving information in the brain. This system is vital to all learning and thinking processes, yet little is known about the physiology of memory storage in the brain. Some researchers suggest memories are stored at specific sites, while others maintain that memories instead involve widespread brain regions working together. Theorists also propose that different storage mechanisms exist for short-term and long-term memories. If memories are not transferred from the former to the latter, then they will be lost (Hole, 1987).

Ashbaugh (1991) suggested that comparison and evaluation processes take place in the brain of the examiner. The medium for transporting the information from the physical realm to the mental realm, however, is the eye – a physical extension of the brain. Ashbaugh goes on to mention that two memory levels exist in the brain: long- and short-term memory. Long-term memory is the main storage area, whereas short-term memory accommodates thoughts we want to remember only temporarily. Friction ridge comparison takes place in short-term memory. This concept was also mentioned in earlier studies by Osborn (1946) and Byford (1987). Form perception, on the other hand, resides in the physical pathway from the eye to the brain, and does not involve short-term or long-term memory.

Even though the problem of form perception has no noticeable association with memory, it nonetheless is involved in some form perception tests. The purpose of testing memory is to distinguish whether an individual is able to retain recently-acquired information long enough to conduct a comparison. If an applicant cannot perceive what is actually focused on the retina, then he or she cannot memorize the image correctly. This does not suggest that form-blind individuals have memory impairment, nor does it suggest that individuals with a memory deficit have form blindness. There are individuals who have poor form perception but sufficient memory capabilities – and vice versa. If an applicant is not form blind, then he or she has an opportunity to maintain an accurate image in short-term memory. In the field of latent prints it is well documented that if a side-by-side comparison is not possible, then a certain quality of photographic memory is necessary to conduct the comparison. As such, examiners who cannot shut their eyes and mentally reproduce target details of a latent print probably do not see much more with their eyes open (Osborn, 1939).

By understanding the visual pathway, one can see that the eyes are simply a gateway that reflects light to the brain, and that short-term memory is simply a storing mechanism for the perceived images. An understanding of the entire visual process establishes that form perception actually takes place in the brain – not the eye – and before the image reaches the short-term memory, not after.

Medical Profession and Form Blindness

Years ago, it was believed that children with Attention Deficit Disorder (ADD) and dyslexia were mentally challenged; research has since proved otherwise (Leisman, 1976). Similarly, some people ignore the existence of form blindness.

Form blindness affects only a small percentage of the nation and, in most cases, goes undetected. Most ophthalmologists agree that form perception is not an eye problem but rather a translation problem. Dr. R. Pharr (personal communication, September 24, 2008), an ophthalmologist at Complete Family Eye Care in Brandon, Mississippi, and Dr. W. C. Ashford (personal communication, September 24, 2008), an ophthalmologist at Ashford Eye Clinic in Jackson, Mississippi, agree that bad form perception cannot be repaired through tests and therapy. As expressed by Dr. Woody Davis (personal communication, September 24, 2008), a practicing ophthalmologist in Meridian, Mississippi and retired Navy flight surgeon, “You either have it or you don’t.”

Surgery or glasses usually do nothing to change the way the brain processes visual information. Wade & Swanston (1991) argues that visual disabilities in the brain can be overcome to a certain extent by practicing vision therapy, a form of supervised training aimed at improving visual skills (such as eye teaming, depth perception, tracking, and vision-body/hand-eye coordination). Wade claims this method of training is a very effective form of physical therapy for the brain and eyes, with some recovery to vision impairments witnessed for those undergoing this type of rehabilitative therapy. With practice, the individual can improve but not to a significant degree. According to Wade, vision therapy – though unproven – may be the only rehabilitation effort likely to help in the area of form blindness.

In summary, the ability to see minute differences in angles, forms, and sizes is best explained as a fine-tuned talent not possessed by every person. According to Dr. R. Pharr (personal communication, September 24, 2008), form perception (or recognition) takes place in the visual cortex of the brain – not in the eye. This does not mean that something is wrong with an individual's brain when unable to perceive form. It simply means that the talents of form blind individuals may not lend themselves to the latent print or questioned document fields. Being a form blind individual does not indicate a lowered intelligence; rather it simply means they cannot distinguish minute differences in angles, forms, and sizes. Although no technology has the capacity to detect exactly where in the brain this ability is lost, there are ways to test for the deficiency.

Form Perception Tests

Several commercially available tests focus on the specific topic of form perception. Most of the commercial tests, however, are costly and must be administered by a psychologist. A brief description of each test is provided.

Commercial Tests

1. Graves Design Judgment Test – measures artistic ability (Uttal, 1975).
2. Barron-Welsh Art Scale – separates the artist from those with lower artistic ability by sorting various designs into preferred and non-preferred categories (Zusne, 1970).
3. Perceptual Speed Test – form matching task that measures the perceptual speed of an individual. Perceptual speed involving form discrimination is a component of certain jobs to maximize the agency's time. The performance of an individual on this test is a reflection of his or her perceptual speed (Uttal, 1975).
4. Perceptual Forms Test – figure-ground perception test which uses overlapping and hidden or embedded figures; diagnostic test intended to uncover deficiencies in visual perception that might affect learning various tasks emphasizing visual perception (Uttal, 1975).
5. Gestalt Completion Test – recognition test where the individual is asked to mentally complete an incomplete figure (Reed, 1973).
6. Group Embedded Figures Test – intelligence test with a visuospatial component; nonverbal and logic based (Dodwell, 1970).

7. Raven's Progressive Matrices Test – conceptual ability test which measures spatial intelligence and suitability for work requiring accurate judgments (Byford, 1987).

Discussion of Variables

The following section of literature review will discuss the purpose of selecting the variables that were used for the purpose of this research. Each variable, corrective versus non-corrective vision, traditional versus nontraditional student status, grade point average, age, and science versus nonscience academic major participation, has a purpose for use which is further discussed within this section. The variable of age was mainly used to determine the traditional or nontraditional status distinction of the test participants. The age of 24 was used as the lower limit for age as describing a test subject as being a part of the nontraditional group of participants. However, since age was recorded, it was used as a separate variable during analysis.

Corrective Versus Non-Corrective Vision

Most employers comprehend the simple truth that individuals with visual impairments are generally less capable of performing tasks dependent on visual acuity. In the case of form blindness, however, individuals afflicted with perception or memory disabilities may nonetheless have perfect vision. Conversely, though, a person requiring a visual aid (such as glasses, surgery, or contact lenses) may have no form blindness disability at all, and may outperform someone with perfect vision on certain job tasks. Hence, an employer may be screening and rejecting applicants without merit. This practice, without justification, could be deemed illegal by virtue of the Individuals with Disabilities Education Act of 1997 and the Americans with Disabilities Act (ADA) of 1990. These laws collectively protect individuals with physical impairments through mandating that they be provided with appropriate educational accommodations when possible (Walker, 2006). Patterson (2000) claims that the new ADA law had little or no effect on universities and colleges, as universities were already adhering to the "provisions of Section 504 of the Rehabilitation Act of 1973" (p. 68). The provisions of the ADA define a person with a disability as "anyone with a physical or mental impairment that substantially limits one or more life activities" (p. 68).

Flener (1993) reports that visually impaired students have been granted special attention for a long time, actually dating back to an early report in 1900 which first documented the mainstreaming of blind children into the public school system. Flener adds that by 1964 over 80% of large school districts (more than 25,000 students) hired instructors for students with visual handicaps. At the end of World War II, public schools in the United States had begun to afford beneficial options to visually handicapped students; one such benefit was the allocation of a full-time special classroom with a teacher available for the entire school day. By this time, visually impaired students were in the same classes with the general student body.

By the year 2006, 60% of U.S. students with visual disabilities were educated in regular classes for at least a portion of the school day (Walker, 2006). The use of specialized teachers was even more important because (as

Walker claims) one third of partially-sighted children have additional disabilities such as mental retardation, hearing impairment, cerebral palsy, and seizures. Although the connection between latent print analysis screening and how visually handicapped individuals are schooled may seem odd, it is important. The historical background regarding how children with vision disorders were schooled can address the issue of how and through what means such individuals overcame their disabilities.

According to a study by Phillips (1994):

> Fairness notwithstanding, the score of any person who is tested under nonstandard conditions does not have the same meaning as the scores for persons tested under standard conditions. One can reasonably assume that the business community and the public at large do not want diplomas and licenses to have different meanings for different individuals. (p. 101)

When accommodations for visually impaired students are implemented through the use of tests in large print or Braille, it is reasonable to presume that the skills sought to be measured are in fact being measured. The intent of using a large print or Braille edition of a test for a student with visual acuity problems is not to alter the cognitive skill being tested but rather to eliminate the impact of the unrelated visual disability. However, when such students have tests read aloud to them, it does skew the accommodation of the visual constraint with a change in the skill being tested (Phillips, 1994).

In summary, it is reasonable to suggest that the impact of visual impairments on careers requiring high levels of visual acuity would be particularly problematic regardless of the quality of one's primary and secondary education. This is not to say that all such career paths are off limits or otherwise unattainable by the visually impaired, but it does appear that such individuals, depending on their level of impairment, would be unable to perform some visual tasks as competently as many of their normal-sighted counterparts assuming all other things are equal. For instance, Ryan (2002) notes that some forensic scientists may be required to work with microscopic slides and other evidentiary materials which require fine-tuned levels of vision, while others may be assigned activities that do not carry these same vision-related responsibilities.

Dr. W. C. Ashford (personal communication, September 24, 2008), an Ophthalmologist at Ashford Eye Clinic in Jackson, Mississippi, argues that a visually- impaired person with corrective vision (such as surgery, glasses, or contact lenses) would be as good (or better) at visual tasks compared to their normal-sighted counterparts as long as visual memory and perception are equal. Dr. J. Thomas (personal communication, September 24, 2008), an Ophthalmologist at the Center for Eye Care in Biloxi, Mississippi agrees with Ashford but believes that vision does play a role, due to the fact that if the person being tested for form blindness believes they have good vision, but actually does not, the results could be misinterpreted to indicate form blindness when the person actually has a form of visual impairment. Both doctors have concurring views, however, that good vision coupled with good form perception produces the best equation for ensuring success in comparing prints.

Predicting Workplace and Academic Success of Traditional Versus Nontraditional College Students

Predicting workplace success of traditional and nontraditional college students after graduation is a relatively scarce area of research. One of the largest concerns a researcher faces is that individuals are difficult to study over an extended period of time. Tracking workplace performance of any college graduate (traditional or nontraditional) over a lifetime is virtually impossible. For example, individuals may die, change married names and job locations, and even move.

According to Strage (2008, p. 255), studies up into the 1980s calculated a template for academic performance for traditional college students:

> This formula included the adequacy of students' academic preparation, the appropriateness of their educational expectations and career goals, the 'anticipatory socialization' they had received from parents, peers, and others prior to entering college, and their assimilation into their new milieu upon matriculation.

Even though the numbers of nontraditional students have been on the rise, there is still a need for more research studies focusing on the correlation between age at college enrollment and post-graduation job performance. Strage further states that "Relatively little is known and much is assumed about differences in college students' experience and success as a function of their age, the route they travel to arrive at the University and their general experience with college" (p. 226). What is known, however, is that traditional-aged students choose college because it is the next logical step upon completion of high school. Quite opposite, though, are nontraditional students who choose college to improve existing careers or as preparation for a different career.

Although there is little literature on job performance for these differing age groups, there is a wealth of research pertaining to academic success and how nontraditional students compare with traditional students. For example, one variable often explored is the coping styles of traditional and nontraditional students when confronted with stressful situations, and how those responses contribute to academic and professional performance. Nontraditional students have generally acquired more life experience, maturity, problem-solving abilities, and other life skills compared to their younger traditional classmates who often lack such wisdom. Motivation also factors into the performance equation. Adult learners who are working in an existing profession may receive a monetary pay increase, while traditional students still may not even know where they will be working (Morris, Brooks, & May, 2003).

Research by Morris et al. (2003) also examined how students cope with stress, and found that traditional and nontraditional status, coping skills, and academic goal orientation were correlated with one another. The most significant finding revealed that nontraditional students achieved higher academic success as measured by GPA. The reason for this greater academic success appeared to be that nontraditional students incorporated more learning goal orientations and task-oriented coping skills than did traditional students. Similarly, Eppler and Harju (1997) found that the adult learner more frequently adapted specific learning goals and were more disciplined in following the goals when compared with the traditional learner. Although neither research study addressed job performance after graduation, Morris et al. suggest that these results could be used to predict future work-based performance. It could be further assumed that an individual more adept at coping with stress in academic settings would also be able to cope with stress in the workplace.

Assessing the quality and delivery of coursework also presents problems when attempting to predict professional and/or academic performance for traditional and nontraditional students. In recent years, there has been a rapid increase in distance learning for the nontraditional student. Vedder (2004, p. 50) explains:

> The University of Phoenix's total per student operating cost is about one third of those of a traditional state university. Schools like Phoenix have vastly fewer non-teaching employees, no elaborate student services, no athletic teams, no libraries, research activities, or cultural programs. They do one thing, teach, and if consumer satisfaction is any guide, do it reasonably well.

Because of this trend, traditional and nontraditional students have vastly differing experiences. Even within traditional university settings, the nontraditional student has the option of more online courses. Thus, it becomes difficult to compare the success of the two groups considering their academic courses were offered through two totally different delivery methods. Vedder states (p. 51):

> Alternatives to traditional higher education are growing in importance as the mainline non-profit universities become more expensive. Aside from attending low-cost community colleges, some are foregoing college altogether to become privately trained, such as becoming an Oracle- or Microsoft-certified computer technician.

Though distance learning is a future trend offering enhanced flexibility for adult learners, research indicates that student-instructor interaction correlates with academic success. Woodside, Wong and Wiest (1999) used student SAT scores to predict academic success, and found that students with more faculty interaction met or exceeded such expectations based on earned GPA. On the other hand, students receiving little faculty interaction actually had GPAs below their predicted academic thresholds based on SAT scores. Another investigated variable related to topics discussed during the faculty-student interaction. In short, the researchers found that the most significant topics correlating with academic success were interaction on 1) class specific material and 2) future careers and goals. "Taken together, the existing research suggests that student-faculty interactions are important to a college experience" (p. 730).

Life experience also is a variable with potential importance regarding academic success of nontraditional and traditional college students. To gain life experience, however, individuals need to experiment and learn from ensuing mistakes. Most of the time, unwise experimentation occurs in one's younger years. Grello, Welsh, and Harper (2006) found that college attendees under the age of 24 were most likely to experiment with extracurricular activities that most adults (nontraditional students) have outgrown. One example of such experimentation included "that 70 percent of college students report having engaged in intercourse with partners they did not consider romantic" (p. 255). Obviously, this doesn't mean that individuals within nontraditional age categories do not partake in sexual experimentation, but it is safe to conclude that adult learners have fewer experimentation distractions compared with their younger classmates.

Rinn (2005) adds that maturity is a function of how well an individual performs in college. He cites two forms of maturation that factor into academic success: self concept and academic concept. *Self concept* describes how people perceive themselves through life's lessons, while *academic self concept* reflects how students perceive their own academic competencies. Studies reveal that during a traditional student's first year of college, academic self confidence goes down. After the first year, though, that academic confidence continuously grows until graduation. The problem with use of such data, however, is that the rise may be a reflection of little more than a positive skew produced from the loss of low concept students dropping out of school, leaving only data available for students with high self concepts and academic self concepts at graduation. Rinn also claims that academic self concept and age appear to rise concurrently. His research concludes that academic self concept increases in early adulthood –

the age of a traditional student (under 24 years of age). Using this variable singularly, it would seem relatively easy, then, to assume that nontraditional students would automatically have an advantage for academic success. However, taking into consideration professional performance, both groups are above the curve for low academic self concept when starting a profession after graduation.

Finally, there is the matter of attrition among traditional college students. Essentially, attrition appears to skew the relationship between age at college entry and subsequent academic performance (which may be predictive of future workplace success). In this regard, Rinn (2005) suggests that the self concept of academic performance for traditional college students tends to decline during the freshman year. By the time of graduation, though, their academic self concept actually exceeds that which was present at the beginning of their freshman year. This increase in academic self concept is attributable to both a general maturation and a process of *selective mortality*. Rinn explains that selective mortality means that traditional college students performing poorly and with inadequate coping skills will drop out of college, thereby resulting in a traditional student cohort possessing positive perceptions of their abilities. Researchers have determined that the academic self concept of traditional college students is a strong predictor of subsequent school drop out, suggesting that traditional college students with low academic self concepts and poor coping skills may simply cease their academic pursuits. According to Rinn (p. 157), "Academic self-concept may also increase as a function of age. Research indicates academic self-concept increases naturally during late adolescence and early adulthood, which corresponds with the college-age years."

Finally, traditional freshman college students of varying academic abilities may seek to attain exceedingly high educational goals as their aspirations are more idealistic than realistic. Rinn (2005) notes that "academically talented men and women generally enter college with aspirations that correspond to their academic ability" (p. 158), indicating that these traditional college students may well possess relatively reasonable expectations for future workplace success.

Use of Grade Point Average on Predicting Success in the Workplace

In the business world, it is important that company executives be able to identify quality and competent workers. There must, however, be a short learning curve. The organization, according to Reiter, Young and Adamson (2007), must put a high priority on predicting success due to the rapidly increasing costs of training new students fresh out of college. As a consequence, research continuously searches for predictors capable of locating the most qualified applicants. According to Allred (1991), it has become common practice to use tests as screening tools, such as administrative assistants passing keyboard proficiency tests, colleges using the Scholastic Aptitude Test (SAT), governments using civil service tests, and even preschoolers being required to score high on intelligence examinations for admission. All of these stated examples provide an objective means for evaluating individuals best suited for a particular job, training, or educational institute based on a specific testing instrument.

Economics also plays a factor in the selection process. High costs associated with marketing, recruiting, and retention of competent workers makes it good business practice to determine which predictive variable has the greatest reliability. According to Bretz (1989), the cost of legal battles could arise if an employer uses an invalidated prediction method. The validation process for a predictor variable should ensure that the instrument does what it is supposed to do and only selects individuals that meet or exceed certain criteria. One criterion Bretz discusses in detail is the use of grade point average (GPA) as a predictor of success in the workplace.

According to a seminal study by Bretz (1989, p. 11), "An issue of major importance to virtually every business is the ability to predict a priori which applicants will eventually prove to be successful employees." Bretz used several predictor variables to predict workplace success, including application blanks, biographical inventories, interviews, work sample tests, and intelligence, aptitude, and personality tests. Included in the biographical data was academic achievement as measured by GPA. Bretz collected data on 328 graduates (mostly undergraduate, n = 277) from business schools in three Midwest universities. Regression analysis showed that overall GPA was not a good predictor of adult work-related success, though there were no statistically significant findings. The data provide reasons why GPA as a predictor of work-related success should be scrutinized before use. Bretz points out that many employers still choose GPA as a predictor – even though it has low validity – for the simple reason that the information is easily obtained and less expensive to obtain. Some businesses choose to use aptitude tests that may be higher in predictability, but are then forced to pay high fees for their usage. An employer with less capital may choose the cheaper assessment.

According to Ridgell and Lounsbury (2004, p. 607), “Over the last several decades, researchers have investigated relationships between numerous predictors and job performance. Many employers screen job applicants based on a minimum grade point average threshold, or consider grades as a heavily weighted criterion when analyzing resumes.” They explored predicting success with general intelligence, personality traits, and work ethic in relationship to two separate college level academic performance measures: single course grade and self-reported GPA. In their study, 140 college undergraduates enrolled in an entry-level psychology course were chosen as test subjects. Using descriptive and correlation statistics, the researchers found that two variables had significant correlations with self-reported GPA at a statistically significant level ($p < 0.01$): general intelligence and overall course grade. The researchers concluded that work ethic and determination also predicted GPA. One limitation of their study is that all tested participants came from a low-level college class, therefore not representing a wide range of ages. Unlike the research conducted by Bretz, this study predicted more academic success than work success.

Hough and Oswald’s (2000) personnel selection study used data collected over four years (1995-1999). The research included job criterion variables which included job knowledge, cognitive ability, academic achievement (GPA), language proficiency, personality traits, conscientiousness, integrity, customer service, self evaluation, and race and ethnic background. A meta-analysis looked at relationships among the variables and concluded that undergraduate GPA was a statistically significant measure within many kinds of jobs. It was, however, more predictive of job performance as college graduation occurred closely with the hiring date. For example, GPA would not be as predictive for an individual twenty years into their career with many occupational changes.

While there are multiple reasons GPA is used to predict workplace success (economical, easily obtainable, valid), there are many more limitations to consider. Bretz (1989) claims that one's GPA varies depending on their school level. Furthermore, curricula differ from one school to another, as do course codes and descriptions. Even with the same curriculum, the style of instruction usually differs among instructors, thus giving rise to varying levels of academic rigor. It is likely, though, that undergraduate GPA would differ even within the same college depending on the choice of academic major because the degree of difficulty between majors would surface. The research also points out that less ambitious students may take an easier course to enhance the probability of obtaining a higher GPA. The more ambitious student, on the other hand, may receive a lower grade because they were more concerned with obtaining knowledge.

GPA does not take into account various non-academic activities (such as sports or parenting) that may limit the amount of time a student can prepare for a specific course. An employer may then find it more advantageous to hire an individual with modest grades but who participated in multiple extracurricular activities than an individual with exemplary grades with no outside activities. Bretz (1989, p. 20) states "Research has shown that general intelligence is a good predictor of success in virtually every job. GPA should be interpreted as what it is and should not be assumed to be a measure of intelligence." Simply put, GPA has too many limitations to be a reliable predictor of success. Potential employers who truly wish to select employees based on intelligence, however, have an abundance of standardized tests at their disposal.

Science Majors Versus Nonscience Majors as a Predictor of Success

This section focuses on college major (science versus nonscience) as a variable to predict professional success in the workplace or professional schools. The variable is important because the most powerful tool in the field of latent prints may be the eye and perception of an individual. As such, individuals with limitations in these areas likely should be excluded from the hiring pool based solely on scientific background. The Mesa Police Department (Colorado) latent print examiner job description gives preference to science majors (Mesa Police Department, n.d.). Jon Byrd (personal communication, September 23, 2008), a certified latent print examiner for 15 years, claims what when he entered the field of latent print examination (in 1992) he was rejected because of his nonscience degree in criminal justice. Now, though, Byrd is the director of the Bureau of Forensic Services in Hattiesburg, Mississippi.

There is no available literature directly dealing with the success of science and non-science majors in latent print examination; therefore, one is relegated to relying on closely-related literature to inform. One example would be to discuss requirements placed on students entering professional schools or graduate schools. According to the University of California at Berkeley Career Center website (2008), students have accepted many myths about the real requirements needed for graduate school or professional schools. One cited myth was "It is commonly believed that certain majors are better than others for applying to law school, and that a science major is best if one is applying to medical school" (¶ 1). The reality, however, is that no one major is preferred, as most law schools look for diverse undergraduate curriculums focusing on both analytical and writing abilities. Conversely, though, medical schools do require a well defined set of prerequisites, but can obtain a science or nonscience degree without discrimination.

According to Brieger's (1999) examination of medical students at The State University of New York at Buffalo, there was no statistically significant difference in academic achievement in preclinical science courses between nonscience and science majors. Furthermore, a study conducted at The University of Kentucky Medical School (Elam, Lenhoff, & Johnson, 1997) found that clinical faculty wanted to see applicants complete more courses in the humanities prior to their arrival at medical school, while basic science faculty wanted to see more classes in the sciences.

These previously-mentioned studies from Brieger and Elam et al. are closely related to forensic science education because most disciplines under its umbrella are hard physical sciences (biology, chemistry, and physics). In university settings, most forensic science programs are housed within the

Department of Chemistry, and as such could easily produce a bias toward science (AAFS, 2008). Within crime laboratories, too, directors hold advanced degrees in the hard sciences (Furton, Hsu, & Cole, 1999), which in turn could bias the construction of job descriptions even though the discipline of fingerprinting is not a hard physical science.

One study about the Biology Department at Louisiana State University (Sundberg & Dini, 1993) looked at both science and non-science student groups by dividing them into separate courses. Non-majors took a course entitled "Chemical Foundations for Cells" (p. 300), covering 3-4 objectives per chapter as deemed important by the biology department. The faculty was instructed to focus on current issues and application to daily life. Meanwhile, science majors enrolled in a course entitled "The Nature of Molecules" (p. 300). Here, the faculty was instructed to cover the same 3-4 objectives covered in the non-major group, but also added concepts and went into greater depth and explanation. Both groups were given a pretest. The research expectations were that science majors would score higher than non-majors on the pretest and posttest due to increased interest and prior preparation, and also would score equal to or higher than the national average.

In order to support the results found in their initial study, these same researchers repeated their work using two different subject areas than their initial study at LSU, ecology and evolution. Surprising to even the researchers, the results showed that science majors did not perform significantly better than non-science majors. In fact, the reverse actually happened, with non-science majors scoring higher (as a group and individuals) on identical posttests. In summary, the researchers found that their beliefs and assumptions were insufficient and that scientific research was needed on the comparison of science and nonscience majors, even if the result is additional hypotheses. More importantly, though, the study showed employers and university administrators that maybe students are more equal in the sciences than once thought.

Summary

Several key concepts have been reviewed regarding the prediction of one's ability to succeed in the profession of latent print examination. The following summary will outline those concepts and list the generally accepted relationships. The concepts appear in the same order as they appeared in the body of the literature review.

1. Form blindness does not occur in the eye, but rather in the brain.
2. Form blindness affects only a small percentage of individuals who experience translation problems.
3. Prescribed surgery or glasses do nothing to change the way the brain processes visual information.
4. The ability to see minute differences in angles, forms, and sizes is a talent not everyone possesses.
5. Therapy is available for form blindness, meaning individuals can improve their abilities – but not significantly.
6. An individual may have perfect vision yet be form blind, while a person

also may need corrective vision (glasses/contact/surgery) but have no form blindness.

7. Traditional students choose college because it is simply the next step. On the other hand, nontraditional students choose college to improve their current career or prepare them for different careers.
8. Nontraditional students achieve higher academic success (GPA) due in part to their enhanced coping skills when compared to traditional students.
9. Faculty/student interaction improves academic success for both nontraditional and traditional students.
10. There is conflicting literature concerning the ability of GPA to predict workplace success. However, it seems clear that specific job-related aptitude tests are more predictive.
11. Cost plays a role in deciding what screening tool is administered, as GPA is cheaper because of its easy accessibility.
12. The literature suggests that science and non-science majors perform equally well in both law schools and medical schools; the assumption here is that both have equal training potential in the sciences and law, regardless of undergraduate major.

CHAPTER III

METHODOLOGY

This chapter describes the research methodology employed during the course of this study. A description of the subject selection process, data collection process, and statistical procedures utilized in analyzing the collected data are included.

Overview

The researcher employed a correlational design to determine whether form-blindness testing significantly predicts an individual's ability to perform latent print examination tasks. Specifically, the study examined whether age, GPA, traditional/nontraditional status, corrective vision, science background, form blindness, and fingerprint training affects a test taker's ability to compare and identify latent prints.

Research Design

The dependent variable in this study is the score on the latent fingerprint comparison test. Meanwhile, independent variables are divided into two groups: performance measures and demographic attributes:

- Performance measures
  - Form blindness scale: an instrument measuring an individual's degree of form blindness on a scale from 100 (no form blindness) to 0 (complete form blindness).

- Fingerprint pattern recognition test: an instrument measuring one's ability to group fingerprint patterns. The test is scored by dividing the number correct by the number attempted.

- Demographic Attributes
    - Age: Age was used as both scale data (H_1) and ordinal data (H_2 and H_3).
    - Grade point average (GPA): GPA is based on a standard 4-point scale as reported by participant.
    - Traditional and nontraditional student status: A nontraditional student is a student 24 years of age or older when admitted to a university or community college; these age subsets were used in two hypotheses (H_2 and H_3).
    - Science major: A student majoring in a science discipline (to exclude administration of justice and geography).
    - Corrected/corrective vision: For the purpose of this study, students with a visual impairment that is corrected by standard glasses, contact lenses, or other visual aids/enhancements.

Participants

Two student groups were tested in this study. First, the untrained group consisted of students enrolled in courses within the field of forensic science at a university in the southeastern United States during the spring 2009 academic term. Students retained within the untrained group were those that had not taken a science of fingerprinting course or had any prior fingerprint training. This subject-selection strategy was designed to enhance the 1) sample size, 2) variety of academic backgrounds (science and nonscience), and 3) distribution of student ages. Conversely, the trained group consisted of form blindness and fingerprint pattern recognition test scores for 160 students who completed a science of fingerprinting course during the years 2003 to 2007 (archival data). The form blindness and pattern recognition scores were graded assignments, while the latent fingerprint comparison test served as the final examination. No data from these tests were previously used for research purposes.

Science of Fingerprinting Training

The science of fingerprinting course used for the trained groups was a 16 week academic college course worth three hours of credit. The course is intended to give students an overview of the entire field of fingerprinting. Upon completion of this course, students will understand the following concepts: pattern identification, fingerprint classification, proper techniques used to collect full sets of known fingerprint impressions, how to properly recover latent print evidence located at the scene of a crime or from evidence submitted to the laboratory, basic fingerprinting methodology, friction skin morphology, analysis and comparison of latent print techniques, and analysis, comparison, evaluation, and verification (ACE-V). The course syllabus for the academic institution is included in the Appendix A. This course is similar in content and instruction to practitioner type courses used to train latent print trainees. One such course is the Introduction to the Science of Friction Ridge Examination offered by Ron Smith and Associates, Inc (Smith, 2009).

The course syllabus from Ron Smith and Associates consulting firm is also placed within the appendixes (see Appendix B) to illustrate the similarities between the academic and practitioner coursework. This course was used for comparison to the academic course for the purpose of this study due to the fact that the course is a certified course that has been given approval and been endorsed by The International Association for Identification (IAI). This organization was previously discussed in detail in chapter one. Also, what makes these two courses even more similar is that both instructors are internationally certified as latent print examiners through the IAI.

Differences between the two courses are two fold. One, even though the contact minutes of class time are similar (40 hours), the format differs. A college course is sixteen weeks in length with instruction time of one hour and fifteen minutes and taught two times a week while the practitioner course is taught in a five day instructional period with eight hours of instruction each day. The second difference is that the academic rigor is a college setting is greater due to the fact that college students are subjected to exams, quizzes, and writing assignments.

In summary, both courses show enough similarity to make this an ideal situation for this comparison as part of this research project since both courses have students who are new to the field of latent fingerprint analysis and the possession of no prior knowledge of the subject is assumed.

Procedures

The researcher contacted instructors for forensic science and administration of justice courses at a university in the southeastern United

States. Once multiple testing dates were scheduled, the researcher administered the tests to untrained group members in the respective classrooms, which included an oral presentation regarding all research purposes and protocols. The researcher then provided each subject with a confidentiality agreement guaranteeing that 1) no collected information will be released to any agency or individual and 2) all tests will remain in a secure location for the duration of the research project. After signing and receiving a copy of the confidentiality agreement, subjects were then asked to complete the form blindness scale and the fingerprint pattern recognition tests. Untrained group members also provided demographic information to include: name, age, GPA, major (science or nonscience), and whether some form of corrective vision is used (glasses, contact lenses, or other form). The demographic information for trained group members was collected at the beginning of their course enrollment. An Internal Review Board (IRB) application form was filed and accepted for the purpose of this study. The approval form may be observed in Appendix C.

Approximately two weeks after students completed the form blindness and fingerprint pattern recognition tests, untrained group members were given a latent fingerprint comparison test similar to that administered to potential latent print examiners at the end of their training. Only the name of the individual was collected at this time to allow for the linking of test scores.

For the experimental group, archival data was collected from instructor records within the forensic science program upon approval of the academic chair of the department in which this study will take place at the university in the southeastern United States (See Appendix D). The archival data was acquired from the instructor of the science of fingerprinting course at a university within the southeastern United States from the years 2003 to 2007. The archival data included the form blindness scale, fingerprint pattern recognition test, and the latent fingerprint comparison test. The instructor collected demographic data for all students at the beginning of the course and also collected demographics for control group members in this study.

Instrumentation

There were three instruments used in this study.

1. Latent Fingerprint Comparison Test

The Federal Bureau of Investigation (FBI) granted the researcher permission to use this assessment tool (see Appendix E). The test has been continuously used for more than 25 years, and as such its validity is assumed. The test contains 99 looping patterns (all ridges flow in the same direction) to train an examiner's eye to distinguish minute differences and similarities in patterns sharing a high degree of likeness.

All prints were placed on an 8.5 by 11 inch sheet of copy paper, with each print less than one square inch in size. The trainee was instructed to identify 48 matching pairs of prints. For a higher level of difficulty, three prints had no matches. The students were provided with an answer sheet labeled one through ninety-nine; for each number they were instructed to place the corresponding match. For example, if print "1" matches print "50," the test taker would write "50" in the space provided by "1." Similarly, the test taker would write "1" in the space provided next to "50."

The test was scored by adding one point for each correct match for a total of 96 points. The student received one point for each non-match correctly identified. The test taker was instructed to mark "non-match" or "non-identifiable" in front of prints with no match (only for the three numbered spots). For simplicity of grading, each student started the exam with one point. The test is a timed test of three hours. A score of 100 reflected the most competency whereas a score of one indicated the least competency.

2. Pattern Recognition Test

The Pattern Recognition test was used by permission (see Appendix F) of the Pima County Sheriff Department's Forensic Science Unit in Tucson, Arizona (Bright-Birnbaum, personal communication, September 4, 2008). The test is used as a preliminary mechanism to hiring an individual for the job of Fingerprint Technician or Latent Fingerprint Examiner Trainee, and was assumed valid due to its use by the Pima County Sheriff's Office for over 20 years.

The pattern recognition test contains 50 lines of six large fingerprint patterns (larger than one-to-one) used to test one's ability to recognize basic pattern forms. All students were given a Scantron answer sheet to mark their answers. The 15-minute timed test consisted of 50 questions. The participants were instructed that they did not need to complete the test due to the fact that the test was graded on the number of questions attempted. This test is not a comparison test in which a student is expected to spend a large amount of time on one question. A minimum of 15 questions, however, must have been answered within the allotted time for the individual to be included in this study. Thus, a test with fourteen attempted questions was discarded (even if all answers were correct) due to the obvious inclination of the individual to exercise extreme caution, which was not the intent of the test. The highest percentage score (number correct versus number attempted) shows a higher ability to recognize patterns.

3. Form Blindness Scale

The form blindness scale is an assessment tool which tests the ability of an individual to recognize five form differentiations. The test was developed by A. S. Osborn and appears in his article "Form Blindness and Proof: Sight Defects in Relation to the Administration of Justice" (1939, p. 248). The instrument has five sub-tests (labeled A, B, C, D, E) and 31 possible points for each section, with percentage scoring derived from dividing the number of correct answers by the total number of questions. The following represents a brief discussion of each test.

- Test A instructs each person to arrange nine circles from smallest to largest according to diameter (using numbers assigned to each circle on an answer sheet).
- Test B instructs each person to examine six triangles with designated numbers, and then write down (on the answer sheet) the numbers that indicate the two equilateral triangles.

- Test C instructs each person to examine a series of eight printed rectangles and write down (on the answer sheet) the two numbers assigned to the rectangles which consist of only 90 degree angles.
- Test D instructs each person to examine nine curved lines (each with an assigned number) and write down the numbers to these lines in order from the least degree of curvature to the highest degree of curvature.
- Test E instructs each person to examine nine sets of two lines drawn to represent varying degrees of angles. Each set of lines is assigned numbers and the test taker is instructed to write down (on the answer sheet) the number of each angle, starting with the set of lines indicating the narrowest to the widest angle.

In cases where a test taker arranged the figures in reverse order from that indicated within the test directions for sections A, D, or E, the researcher graded in reverse order to avoid having to throw out the scores. Regarding the Form Blindness Scale, higher scores reflected a lesser likelihood that one is form blind. For the purpose of this study, the higher the score, the better the student did on the examination.

Permission to use the form blindness scale was secured from J.P. Osborn, the great-grandson of A.S. Osborn (see Appendix G) and the only remaining member of the four-generation family practice of document examiners. The test has been in circulation for more than 60 years. According to G. Regan (personal communication, September 5, 2008), a newly admitted latent print examiner trainee at the National Forensic Science Training Center (NFSTC), the NFSTC still uses the test to screen latent print trainees.

Data Analysis

According to one prominent source (Hair, Black, Babin, Anderson, & Tatham, 2006, p. 169), regression analysis is "by far the most widely used and versatile dependence technique, applicable in every facet of business decision making." As such, multiple regression analysis (ordinary least squares) was employed in this study to examine the relationship between latent fingerprint comparison performance (criterion variable) and several other variables (predictors) thought to influence print comparisons. Alpha levels were set at .05; hypotheses were interpreted along two tails.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this study was to examine variables which may be associated with the performance of latent fingerprint examination. A review of literature (discussed in Chapter II) suggests that some individuals are hired as latent fingerprint trainees only to later determine that they are unable to meet the high quality standards that are required once in that position. However, the literature does not adequately address why this miscommunication occurs. Within this study, information specific to each participant was collected and taken into consideration as possible factors of influence over the participants ability to perform on a series of tests. These tests were used to determine the potential form blindness of the individual participant. Their performance on these tests, which is indicative of the person's ability to perform as a latent print examiner, was analyzed using multiple regression taking into account the characteristics of traditional and nontraditional student status, participation in fingerprint training courses, age, grade point average (GPA), vision (corrected/non-corrected), and academic major (science/nonscience).

Chapter IV presents descriptive data related to the sample population, and further provides results for the multiple hypotheses stated in Chapter I. Two analyses were utilized to investigate the problem. One, descriptive analysis of variables, includes frequency and distribution for individuals within two groups (trained versus untrained). Two, multiple regression analysis, examines the relationship between performance measures (criterion variable) and other predictor variables.

Students for this study were selected from the administration of justice and forensic science programs within a university located in the southeast region of the United States. Students were divided into two groups: trained and untrained. The trained group consisted of 167 participants while the untrained group accounted for 160 participants (making both groups similar in size).

Demographic Information

The primary purpose of the demographic portion of the instrument was to collect attributes from two specific focal groups. The first group (trained) consisted of archival data collected from 2003-2007 from students studying the science of fingerprinting from a university in the southeastern region of the United States. The second group (untrained) consisted of collected data from students with no prior fingerprint training and enrolled in courses in forensic science and administration of justice during the spring 2009 semester. Five pieces of demographic information were sought: age, GPA, traditional versus nontraditional status, academic major (science versus nonscience), and vision (corrective versus non-corrective).

A frequency distribution for both the untrained group and the trained group is outlined in Table 1. The data indicate that participants in the untrained group tended to be 1) traditional-aged students, 2) majoring outside the sciences, and 3) without corrective vision. Specifically, 90 (53.9%) student participants had no corrected vision while 77 (46.1%) had some form of corrected vision. Meanwhile,

Table 1

Frequency Distributions of Participants within the Untrained Group and Trained Groups

	Untrained Group		Trained Group	
Characteristic	Frequency	Percent	Frequency	Percent
Vision				
Corrective	77	46.1	92	57.5
Noncorrective	90	53.9	68	42.5
Student Status				
Traditional	101	60.5	69	43.1
Nontraditional	66	39.5	91	56.9
Academic Major				
Science	74	44.3	58	36.3
Nonscience	93	55.7	102	63.8

101 (60.5%) were traditional students (under the age of 24) while 66 (39.5%) were nontraditional students (24 years of age or older). Lastly, 93 (55.7%) students were nonscience majors while 74 (44.3%) were considered science majors.

The data also indicated in Table 1 that the trained group consisted of participants who tended to be 1) nontraditional-aged students, 2) majoring outside the sciences, and 3) with some form of corrective vision. Specifically, 68 (42.5%) student participants did not have corrected vision while 92 (57.5%) indicated that they were required to have some form of corrective vision. Furthermore, 69 (43.1%) students were 24 years of age or older while 91 (56.9%) were under the age of 24. Lastly, 102 (63.8%) students were nonscience majors while 58 (36.3%) were science majors.

A comparison of the two groups reveals three trends. One, both groups have fewer science than nonscience majors. Two, the untrained group has slightly more traditional-aged students while the trained group has more nontraditional-aged students. Three, slightly more participants in the trained group required corrective vision.

Descriptive Findings

Descriptive statistics for the untrained group and trained group are outlined in Table 2. For the untrained group, the data indicate mean fingerprint comparison test scores were 55.1% (SD = 24.1). Meanwhile, the form blindness scale mean was 83.8% (SD = 8.1) while the pattern recognition test mean was 72.6% (SD = 19.75). Demographically, the mean age for this untrained group 24

Table 2

Descriptive Statistics of the Untrained Participant Group and the Trained Participant Group

	Untrained Group				Trained Group			
Characteristic	Mean	SD	MIN	MAX	Mean	SD	MIN	MAX
Dependent Variable								
Fingerprint Comparison Test*	55.14	24.08	1	100	90.31	12.01	35	100
Independent Variables (Performance Measures)								
Form Blindness Scale*	83.78	8.09	48.39	96.77	84.73	6.69	57.57	96.75
Fingerprint Pattern Recognition Test*	72.60	19.76	26.00	100.00	80.24	16.71	40.91	100.00
Independent Variables (Demographic Attributes)								
Age	24.04	6.08	18	54	26.91	7.68	18	53
GPA	3.04	0.51			3.17	0.46		

*Percentage Correct

years (SD = 6.1) and the GPA mean was 3.03 (SD = 0.51). Another aspect of the data to observe is the range of scores for the untrained group. The fingerprint comparison test showed a low score of 1 and a high score of 100, showing that scores on this test involved the entire possible range. The form blindness scale was observed to have a low score of 48.39 and a high score of 96.77. The observed scores for the fingerprint pattern recognition test revealed a low score of 26 and a high score of 100.

A statistical description of the trained group is also outlined in Table 2. The dependent variable (latent print comparison test) had a mean of 90.31% (SD = 12.01). The performance variables (pattern recognition test) had a mean of 80.24% (SD = 16.70). The form blindness test for this group revealed a mean of 84.72% (SD = 6.68). The mean age for this group was 26 (SD = 7.67) while GPA had a mean of 3.17 (SD = 0.45). Another aspect of the data is the range of scores for the trained group. The fingerprint comparison test showed a low score of 35 and a high score of 100. The form blindness scale had a low score of 57.57 and a high score of 96.75. The observed scores for the fingerprint pattern recognition test revealed a low score of 40.91 and a high score of 100.

Table 2 reveals several observations in need of summary. The average score on the fingerprint comparison test was much higher for the trained group (90.31) when compared with the untrained group (55.14). The average age and grade point average for the trained (26.91, 3.17) and untrained (24.04, 3.03) groups, however, were quite similar. The youngest participant for the both the trained and untrained groups was 18 years of age. The oldest participant in the untrained group was 54 years of age while the oldest participant in the trained group was 53 years of age. Form blindness scale means showed similar averages between the groups: trained (84.72) and untrained (83.77). Lastly, there was a slight difference in the pattern recognition test scores between the trained (80.24) and untrained (72.60) groups.

Tests of Hypotheses

Hypothesis 1:

There is a significant relationship between the criterion variable latent fingerprint comparison test and the best-weighted set of predictor variables from among form blindness scale, fingerprint pattern recognition test, corrected vision, grade point average, academic major (science/non-science), age, the interaction of form blindness scale and fingerprint pattern recognition test, and a latent fingerprint training course.

Regression analysis strongly supports the premise of hypothesis one that a weighted set of variables significantly predicts the performance of college students on the fingerprint comparison test, $F\,(8, 298) = 66.99$, $p < 0.001$, $R^2 = 0.643$. Nearly two-thirds of the variance in latent fingerprint comparison scores was explained through the scores of the seven variables (plus one interaction variable). (Table 3)

Three variables failed to achieve statistical significance with respect to predicting latent fingerprint comparison scores. Regression findings suggest that age, grade point average, and whether a student had corrected vision do not significantly contribute to predicting college student performance regarding the

Table 3

Regression Model for Fingerprint Comparison Test Scores

Independent Variables	b	SE	Beta	Sig
Pattern Recognition Test	2.002	0.523	1.423	0.000
Interaction (PR Test/FB Scale)	- 0.019	0.006	- 1.242	0.003
Training	32.068	1.908	0.615	0.000
Form Blindness Scale	1.885	0.468	0.542	0.000
Science Major	4.151	1.894	0.078	0.029
GPA	2.358	1.895	0.045	0.214
Age	- 0.150	0.134	- 0.041	0.263
Corrected Vision	- 0.072	1.836	- 0.001	0.969

F (8, 298) = 66.99, $p < 0.001$, $R^2 = 0.643$.

Note: PR Test = Pattern Recognition Test.

FB Scale = Form Blindness Scale.

identification of latent fingerprints. Conversely, four variables (five when including the interaction between pattern recognition and form blindness) proved to be significant predictors of latent fingerprint comparison scores. In order of contribution strength (beta), the significant predictors are 1) pattern recognition test, 2) pattern recognition/form blindness interaction, 3) training, 4) form blindness scale, and 5) science major.

Given that pattern recognition explains the most variance in fingerprint comparison scores, and that pattern recognition also significantly contributes to variance explanation through the interaction variable, it is somewhat clear that knowledge of a student's ability to recognize fingerprint patterns is by far the best filtering mechanism for careers in fingerprint comparison. The third best predictor of fingerprint comparison scores is whether a student had completed a fingerprint training course. Students in the fingerprint training course scored substantially higher (B = 0.615) on the fingerprint comparison exercise; this finding is somewhat spurious, though, in that knowledge of fingerprint principles has always been assumed necessary for successful fingerprint comparison. With that caveat, attention turns to the fourth best predictor – that of form blindness. Essentially, the findings of this study reveal that students with diminished form blindness scores have fewer difficulties (B = 0.542) with accurately matching fingerprint specimens. Lastly, though on a more limited scale, students majoring in science disciplines perform significantly better (B = 0.078) than those majoring in disciplines outside the natural sciences.

Hypothesis 2:

There is a significant relationship between the criterion variable latent fingerprint comparison test and the best-weighted set of predictor variables for traditional college students among form blindness scale, fingerprint pattern recognition test, corrected vision, grade point average, academic major (science/non-science), the interaction of form blindness scale and fingerprint pattern recognition test, and a latent fingerprint training course.

Regression analysis also supports hypothesis two that a weighted set of variables will significantly predict the performance of traditional college students on the fingerprint comparison test, $F\,(7,\,149) = 36.31$, $p < 0.001$, $R^2 = 0.630$. Almost two-thirds of the variance in latent fingerprint comparison scores was explained through analysis of the six variables (plus one interaction variable) (see Table 3). As with the regression model for all college students (see Table 3), corrected vision and grade point average again failed to achieve statistical significance for predicting latent fingerprint comparison scores. More importantly, though, two variables – academic major (science/non-science) and interaction between pattern recognition test and form blindness scale – which were significant predictors for all college students did not significantly predict when examining traditional college students alone.

Three variables serve as significant predictors of latent fingerprint comparison scores for traditional students. In order of contribution strength (beta), the significant predictors are 1) pattern recognition test, 2) training, and 3)

Table 4

Regression Model for Fingerprint Comparison Test Scores for Traditional College Students

Independent Variables	b	SE	Beta	Sig
Pattern Recognition Test	1.520	0.733	1.045	0.040
Interaction (PR Test/FB Scale)	- 0.012	0.009	- 0.763	0.174
Training	33.129	2.898	0.585	0.000
Form Blindness Scale	1.386	0.646	0.408	0.033
GPA	4.188	2.950	0.072	0.158
Corrected Vision	1.573	2.836	0.028	0.580
Science Major	1.073	2.824	0.019	0.705

F (7, 149) = 36.31, $p < 0.001$, $R^2 = 0.630$.

Note: PR Test = Pattern Recognition Test.

FB Scale = Form Blindness Scale.

form blindness scale. Even though academic major dropped out of the significance lineup, it is important to note that the relative beta strengths contributed by the three significant predictors ranked identically for the traditional students as they did for the college group as a whole.

The regression model for traditional students differed little from the model for the entire college student group. First, pattern recognition contributed most to explaining variance in fingerprint comparison scores. Second, training continued to segregate successful comparison from unsuccessful efforts; but once again does not provide meaningful insight into understanding fingerprint comparison performance. Lastly, the absence of form blindness again proved vital to successful fingerprint comparison ability.

Hypothesis 3:

There is a significant relationship between the criterion variable latent fingerprint comparison test and the best-weighted set of predictor variables for nontraditional college students among form blindness scale, fingerprint pattern recognition test, corrected vision, grade point average, academic major (science/non-science), the interaction of form blindness scale and fingerprint pattern recognition test, and a latent fingerprint training course.

Regression analysis supports the premise of hypothesis three that a weighted set of variables will significantly predict the performance of nontraditional college students on the fingerprint comparison test, F (7, 142) = 42.94, $p < 0.001$, $R^2 = 0.679$. Just more than two-thirds of the variance in latent

Table 5

Regression Model for Fingerprint Comparison Test Scores for Nontraditional College Students

Independent Variables	b	SE	Beta	Sig
Interaction (PR Test/FB Scale)	- 0.033	0.009	- 2.398	0.000
Pattern Recognition Test	3.115	0.727	2.262	0.000
Form Blindness Scale	3.093	0.667	0.882	0.000
Training	30.729	2.414	0.664	0.000
Science Major	7.321	2.429	0.150	0.003
Corrected Vision	- 2.679	2.289	- 0.056	0.244
GPA	0.589	2.292	0.013	0.797

F (7, 142) = 42.94, $p < 0.001$, $R^2 = 0.679$.

Note: PR Test = Pattern Recognition Test.

FB Scale = Form Blindness Scale.

fingerprint comparison scores was explained through the analysis of six variables (plus one interaction variable). (See Table 5) Again, corrected vision and grade point average failed to achieve statistical significance for predicting latent fingerprint comparison scores. More importantly, academic major (science/non-science) and the interaction between pattern recognition and form blindness reappeared as significant predictors for nontraditional college students.

The regression model for nontraditional students differed little from the models constructed for all college students and the traditional student group. Not unlike our previous models, pattern recognition (after the interaction between pattern recognition and form blindness) and form blindness contributed most to explaining variance in fingerprint comparison scores of nontraditional students, while training also continued to isolate successful comparison from unsuccessful comparison. And, the increasing presence of form blindness again proved problematic for student success in fingerprint comparisons.

Summary of Regression Findings

Regression models were individually constructed for all college students, traditional college students, and nontraditional college students. All three regression models confirmed that latent fingerprint comparison scores can be reliably predicted through knowledge of a weighted set of variables. The full model for all college students did indicate, however, that a college student's membership in traditional and nontraditional age groupings does not significantly contribute to understanding latent fingerprint comparison performance. Moreover, all models rejected the importance of grade point average, as well as whether a student has corrected vision, when predicting latent fingerprint comparison scores.

On a significant note, the most important predictors of latent fingerprint comparison performance – regardless of student age grouping – were pattern recognition and form blindness. Essentially, the regression findings of this study amply demonstrate that the skills required for successful fingerprint comparison careers are highly dependent on one's ability to recognize patterns and forms. The only meaningful difference between the predictive models constructed for traditional and nontraditional students was academic major, with science majors performing significantly better within the traditional student cohort.

CHAPTER V

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

Summary

Summary of Problem

Many organizations and agencies have implemented screening tests for applicants seeking employment as a latent fingerprint trainee. The tests being utilized, however, are quite similar (if not the same) as those used to measure form blindness and pattern recognition. As such, the primary problem within the field of latent fingerprints is that no quantifiable research has been performed to establish these tests as statistically valid.

To discuss the hiring of an applicant based solely on a test with no validation is unjust. It is important to note that the tests used within this study are valid in assessing form blindness only. It is equally important to note, however, that agencies using and trusting such tests should not be perceived as culpable. Organizations must find individuals able to perform the actions necessary required of a latent print examiner to protect its integrity and credibility. Agencies invest large amounts of resources (time and money) on fingerprint trainees (including a two-year training course). The organization uses these tests (though unproven) to prevent unnecessary waste of time and funding, and to prevent trainees from becoming disheartened due to their inability to complete the necessary latent print certification process after the two-year training period. The bottom line of this study was to determine if form blindness and pattern recognition tests could be used as valid predictors of potential success for a latent fingerprint trainee.

Summary of Venue

This study was performed at a university setting because it was believed to be a setting which could adequately mimic work-place environments. The professional arena was not regarded as feasible for this study because of the numerous agencies which would have been required for testing – thus yielding insufficient sample sizes. Moreover, trainees would be at a different employment level by the time they were tested. As a result, there would be no way to monitor what was actually taught due to the varying ability of trainers. At the university setting, faculty members were both seasoned and internationally certified practitioners.

The researcher sought to gauge the effectiveness of the form blindness scale and pattern recognition tests within a group of college students at a university in the southeast region of the United States. The venue was chosen because it met several criteria needed in the study.

1. The course needed to focus on fingerprint science and be similar to professional training courses outside the world of academics. (Research revealed only one other venue outside the southeast United States meeting this criterion.)
2. Students needed to represent diverse academic backgrounds to enable the researcher to compare the two groups of science and nonscience academic majors.

3. Students needed to vary significantly in age to enable the researcher to obtain sample groups of both traditional and nontraditional students.
4. There needed to be other courses other than fingerprint courses (which also met criteria two and three as mentioned above) to analyze groups of trained and untrained individuals.

Summary of Groups

Students were placed in two distinct groups: untrained and trained. The untrained group was compiled of individuals taking courses within the administration of justice department at a university in the southeastern United States. Students consisted of various academic backgrounds and ages, but the commonality among the group was that no participants had previous fingerprint training. This group data was collected during the spring 2009 term and consisted of 167 individuals. Meanwhile, the second group (trained) consisted of 160 students (from the same university) that completed a fingerprint science course during the years 2002 to 2007. Archival data was collected (with approval) from the academic department.

Each of the above two groups had data associated with each individual research participant, including academic major, age, grade point average, and corrected vision. These characteristics were collected to allow analysis of whether any of the factors influenced any of the differing tests. The variable academic major was used to determine any observed correlations between the test outcomes and whether the individual was pursuing a degree in a science or nonscience field of study. The characteristic age was used to determine if traditional (below the age of 24) or nontraditional student (24 years of age or older) status had an effect on the outcome. Grade point average was used to determine if the individual's academic achievement had an affect on one's ability to perform well on fingerprinting tests. Lastly, it was collected whether or not a test subject required some form of visual aid such as glasses or contacts. This was used to show whether or not the corrective vision tool had any affect on the individual's ability to perform on the fingerprinting tests.

Summary of Variables

The dependent variable for this study was the latent fingerprint comparison test used by the Federal Bureau of Investigation. The FBI has used this test for over 25 years to assess latent fingerprint trainees' ability to compare latent prints. The examiner observes and analyzes 99 looping pattern fingerprints and is instructed to match 48 pairs, and label the remaining three prints as non-matches. The highest possible score is 99 points. For simplicity sake, one point is given to each participant to start the exam process. The resulting best possible score is 100 points. A score of 100 points (high ability to compare prints) would be 100% and the lowest score (low ability to compare prints) would be 1%. This examination is administered to both trained and untrained participant groups. The trained group received the test only after successfully completing receipt of instruction in the college level science of fingerprinting course. The untrained group also was given the test, but at no predetermined time and without prior participation in any form of fingerprint training.

The independent variables were divided into two categories: performance measures and demographics. Performance measures included the form blindness scale and fingerprint pattern recognition test. Both groups (trained and untrained) were given the tests at the beginning of the class, and neither group, at the time of the test, had formal fingerprint training. The form blindness scale is a testing instrument designed to provide the researcher with the degree of form blindness exhibited by the individual participant. This test shows the degree of form blindness on a scale of 0 (complete form blindness) to 100 (no form blindness). The fingerprint pattern recognition test is another tool, but is utilized to determine the research subject's ability to group fingerprint patterns.

The independent variables labeled "demographic attributes" includes age, GPA, traditional and nontraditional student status, science major, and corrected vision. Age was used for two specific reasons. First, the data determined the traditional or nontraditional student status by using the ages of 24 and above to be considered nontraditional. Since age was previously collected to obtain student status and was part of the data set, the variable was determined to be further used as an additional independent variable. Grade point average also was reported by the student during the data collection process, and was used to determine if academic success is correlated with success on the fingerprint tests.

Students were also instructed to provide their academic major as either hard science or not science. Within the review of literature, studies were examined to determine if individuals partaking in a scientific field mentally work through problems differently than those not partaking in a scientific field of study.

This research will be used to determine if whether being a science or nonscience major correlates with success on the fingerprint tests. Finally, to show whether or not the use of some corrective vision tool (e.g., glasses or contact lenses) affects an individual's ability to perform on the fingerprinting tests, the students were instructed to report whether they currently use visual aides or enhancements.

Summary of Procedures

Instructors for forensic science and administration of justice courses at a university in the southeastern United States were contacted for use of their classrooms and students for participation. The researcher administered the form blindness scale and fingerprint pattern recognition test to individuals who were untrained in the science of fingerprinting. Individuals were also asked to provide demographic information to include: name, age, GPA, major (science or nonscience), and whether some form of corrective vision is used (glasses, contact lenses, or other form). After approximately two weeks, the untrained group members were given the latent fingerprint comparison test.

For the trained group, the test scores for the form blindness scale, pattern recognition, and latent fingerprint comparison tests were collected – along with demographic information for each participant – from the instructor records of the science of fingerprinting course at the university in the southeastern United States for the years 2003 to 2007.

Three instruments were used in this study. The latent fingerprint comparison test contains 99 looping patterns designed to require the test taker to distinguish minute differences and similarities in patterns sharing a high degree of similarity. The test taker was instructed to identify 48 matching pairs of prints and indicate three prints that did not have a match. The test was scored by adding one point for each correct match and one point for designating each print that did not have a match. The addition of one point to the total provided a test with 100 possible points.

The pattern recognition test contains fifty lines of six large fingerprint patterns designed to test one's ability to recognize basic pattern forms. All participants were given 15 minutes to answer as many of the 50 questions as possible. Participants were instructed that they did not need to complete the test due to the fact that it was graded on the number of questions attempted. An individual must have answered a minimum of 15 questions due to the design of the tool to test the individual's ability to recognize a pattern quickly, not analyze a pattern thoroughly.

The form blindness scale is an assessment tool which tests one's ability to recognize five form differentiations. The instrument has five sub-tests with 31 possible points for each section. A percentage correct score was derived from dividing the number of correct answers by the total number of questions. The following represents a brief discussion of each of the sub-tests.

- Test A instructs individuals to arrange nine circles from smallest to largest.
- Test B instructs each person to determine the presence of two equilateral triangles out of a group of six triangles.
- Test C requires the examination of rectangles to determine which rectangles consist of only ninety degree angles.

- Test D instructs each participant to sort lines by degree of curvature.
- Test E instructs each person sort pictures of lines forming angles from narrowest to widest degree.

The results from the form blindness scale are converted to percent correct and are viewed as the higher the score, the less form blind an individual.

Summary of Major Findings

Based upon the findings of this study, the hypotheses tested in this study were supported. Hypothesis one reveals that through regression analysis, predicting college student performance regarding identification of latent fingerprints can be accomplished at a high degree of significance when looking at pattern recognition test scores, the interaction of pattern recognition and form blindness scale, fingerprint training, form blindness scale, and academic major (science versus nonscience). However, there was no statistical significance when looking at the other variables. The finding shows that age, grade point average, and whether a student was required to have some form of corrective vision do not contribute to the prediction of success on a latent fingerprint comparison test.

Hypothesis two reveals similar findings. Using multiple regression, three variables predicted the latent fingerprint comparison scores for traditional students. Again, the pattern recognition test, training, and form blindness scale all showed to be highly significant. This time, academic major was not significant. Hypothesis two and hypothesis one revealed very similar results.

Hypothesis three regression analysis again shows that corrected vision and grade point average failed to show statistical significance for predicting latent fingerprint comparison scores. In this analysis, academic major and the interaction variable were not significant along with the mainstays of form blindness scale, pattern recognition test, and training.

Discussion

Within the review of literature (see Chapter 4), the research summarized 12 relationships (discussed as appearing in the literature). The first concept stated that form blindness does not occur in the eye, but rather in the brain. The literature is aligned with the statistical analysis, as all three regression models revealed that corrected vision was not a statistically significant predictor for how well an individual performs on a latent fingerprint comparison test.

The second accepted relationship claimed that form blindness affects only a small percentage of individuals with translational problems. Again, statistical analysis supports this statement. The average score on the form blindness scale for the untrained group was nearly 84% (the higher the percentage, the less form blind the individual) and nearly 85% for the trained group. Again, this shows that form blindness does not affect the majority of individuals.

The third statement claimed that prescribed surgery or glasses do little (if anything) to change the way the brain processes visual information. Statement three, like statement one, is supported by the statistical research. Again, self-reported corrective vision of whatever means is not statistically significant in any of the fingerprint comparison regression models.

Statement four from the literature review states that the ability to see minute differences in angles, forms, and sizes is a talent not everyone possesses. This statement is supported by the statistical research. The untrained group had a minimum reported score of 48.39 and a maximum reported score of 96.77 on the form blindness scale while the trained group had a reported minimum score of 57.57 and a maximum reported score of 96.75 (the higher the score, the less form blind). This shows that not all individuals have an equal ability or talent to see minute differences in fingerprint friction ridges.

Statement five from the literature review claims that there is therapy available for form blindness, meaning that individuals may take part in remediation to increase their ability to overcome form blindness (but not significantly). What makes this surprising is that the reviewed literature indicating no statistical support is now supported through a quantifiable study. This study supports the premise that training can help an individual's ability to learn fingerprint comparison. The averages on the final fingerprint comparison test showed a difference of about one third. Also, all three regression models show that even with training, individuals who scored lower on form blindness still scored lower on the final comparison examination. This is perhaps the most significant finding in the study since now agencies could implement the form blindness scale and the pattern recognition test as a bona fide screening tool.

Statement six claims that an individual may have perfect vision and still be form blind, while another person may require corrective vision yet not be form blind. As shown in the statistical analysis, whether you have perfect vision or corrective vision (as self reported), there is no evidence of statistical significance to show a correlation. This is vitally important for the field of adult education since, prior to this study, an employer may have been under the misconception that an older individual's (nontraditional learners) vision would impede their ability to train in the field of latent print examination. Their belief may have prompted them to hire a younger individual with perfect vision and a longer span of time before degenerated vision would occur rather than an older individual. Due to the results of this study, it can be stated that neither age nor vision plays a significant role in the ability of either traditional or nontraditional aged students to train in the field of latent prints. The necessary variable needed to determine success in latent prints is good visual perception.

Claims seven and eight are combined since they both deal with traditional versus nontraditional status. Claim seven states that traditional students (less than 24 years of age) choose college because it is simply the next step. On the other hand, nontraditional students (24 years of age or older) choose college to improve their current career or prepare for a career change. Meanwhile, claim eight states that nontraditional students achieve higher academic success (GPA) due to enhanced coping skills when compared to traditional students. Although the statistical analysis did not take into account coping skills or career motivation, it did show that nontraditional students, for whatever reason, had a slightly higher overall GPA.

Claim nine also deals with traditional versus nontraditional student status. Claim nine states that faculty and student interaction improves academic success for both nontraditional and traditional students. Within the scope of this study, both traditional and nontraditional students encountered similar amounts of interaction with instructors. Therefore, no data were obtained to either support or provide evidence that did not support the above stated claim.

Claim 10 states there is conflicting literature concerning the ability of GPA to predict workplace success. However, it seems clear that specific job-related aptitude tests are more predictive. The statistical analysis performed for this study shows that, in all three regression models, there is no statistical significance regarding GPA as a predictor for how well an individual will perform on a latent fingerprint comparison test. Conversely, all three models show statistically significant correlations for predicting such success from the fingerprint pattern recognition test and form blindness scale. One could draw an analogy between the fingerprint pattern recognition and form blindness tests as being like the job-related aptitude and fingerprint comparison tests replacing workplace success.

Claim 11 states that cost plays a role in deciding what screening tool is administered; thus, GPA is commonly used due to its lack of expense and relative accessibility. No statistical research within the scope of this study answers this question. It could be assumed, though, that the cost of administering one or both screening tests presented within this study could be costly and time consuming.

The twelfth and final statement claims that the literature suggests that science and nonscience majors perform equally in both law schools and medical schools. The assumption here is that both have equal training potential in the sciences and law, regardless of undergraduate major. The statistical analysis within this study shows that one regression model does demonstrate science majors did predict success on the latent fingerprint comparison test for traditional-aged students. However, no other model showed any statistical significance for academic major.

In conclusion, nearly all claims which emerged from the literature were supported by the statistical analysis of this study. This surpassed the researcher's expectations for this study.

Limitations of this Study

This section outlines any concepts within this study that may limit its generalization or application of the findings under particular circumstances.

1. Participants in this study were from one university in the southeast region of the United States, and therefore do not represent an overall cross-section of the general population. As such, generalization is a concern.

2. Correlational research in this study provides a look at significant relationships between variables which appear important in predicting successful performance on a latent fingerprint comparison examination. However, these results should not be overstated since correlation research does not have the ability to infer cause-effect.

3. The length of the fingerprint comparison test averaged 2.5 hours. Even though the time frame for the archival group (trained) was irrelevant since it was part of an academic class (science of fingerprinting), the untrained group took the test voluntarily. Due to this, students may have lost interest and therefore experienced a decrease in their effort by the end of the test.

4. Participants in the trained group were trained by the same instructors. Therefore, the group does not represent an ideal cross-section of all fingerprint science courses taught. This may skew the generalization of the results.

Recommendations for Policy or Practice

This section outlines concepts emerging from this study that may be used to influence current policy and practice within the field of fingerprinting, including training and the latent fingerprint trainee screening process.

1. As often stated throughout this study, it has become common practice to administer visual screening tools to applicants entering the field of latent fingerprint examination. However, no quantifiable research, until now, has investigated the predictive validity of those tests regarding ability to succeed in the field. This study, however, reveals that the form blindness scale and pattern recognition test are statistically significant predictors of such success. The regression models also showed that the two tests interact to form predictive success. If only one test were selected for screening use by a forensic science laboratory, it should be the pattern recognition test. On all three regression models, the pattern recognition test outperformed the other variables in predicting latent fingerprint examination success.

2. It is highly recommended that this study should not be singularly used to validate the form blindness scale (created by A. S. Osborn) and pattern recognition test (Pima County Sheriff's Department's) as screening tools for applicants entering the field of latent fingerprint comparison. Although several variables were tested, it is possible that yet other variables could also predict

success. For example, motivation and determination was not researched but certainly may play a role. It therefore is strongly suggested that the findings of this study be used only as literature to help in the determination of how the assessment of applicants should take place.

3. It is recommended that professional agencies keep in mind that training also serves as a statistically significant variable in predicting success. However, this is a misnomer since it is highly expected that a trained group (after 16 weeks of studying fingerprint science) would outperform an untrained group. Even with this stated, the form blindness scale and pattern recognition tests nonetheless predicted success for the trained group. As noted in the review of literature, Wertheim (1996) claims that "a job requiring a high degree of visual acuity will be extremely frustrating for a person who is form blind, and that person can never become fully competent" (p. 154-155). Wertheim (p. 158) goes on to boldly state that "training and experience alone do not make a good latent print examiner – never have and never will!" It is not the recommendation of the researcher to make such a claim from one study alone. However, it does favor such statements that have been made through the eyes of a Certified Latent Print Examiner (CLPE) with years of experience in training latent print examiners.

Recommendations for Future Research

1. If form blindness testing or other visual acuity tests are going to be utilized as screening tools, then additional studies must serve as the validation for such approaches. In short, more studies need to be performed in order to research this phenomenon.

2. This study should be replicated using other form blindness testing methods referenced in the review of literature.

3. A study should be performed on form-blind individuals to ascertain whether they can be rehabilitated to the competence level of a person with little (if any) form blindness. One might consider this strategy as similar to the training of a dyslexic individual in hopes of them reading at the same level as someone not dyslexic. This research, then, could be utilized to gain a better understanding into the assumption that form blindness cannot be helped with remediation.

4. The last recommendation should be valued by the professional field of latent fingerprint examination. Researchers within the field are encouraged to study themselves, or at least allow others to examine them regarding the concepts contained within this study. For example, it is suggested that agencies not currently using visual testing – to remove applicants from candidacy pools – should replicate this study. Essentially, this would mean that the applicant, after being hired, would be given the form blindness scale as well as the pattern recognition test. Then, after two years of training the latent fingerprint trainee would be eligible for the latent fingerprint certification test administered by the International Association for Identification. The research could then compare the pretests (form blindness scale, pattern recognition, or others) with how well they performed on the certification test at the end of their two-year training period. A study of this nature would be a significant improvement from this study since it would not be based on college students in a controlled educational environment;

rather, it would be based on individuals who had previously been through the hiring process and accepted into the position of latent print trainee.

APPENDIX A

ACADEMIC INSTITUTION FINGERPRINTING COURSE SYLLABUS

COURSE NUMBER: [redacted]
COURSE TITLE: Fingerprinting
SEMESTER: Fall 2008
INSTRUCTORS: [redacted] Guest Lecturer: [redacted] Certified Latent Print Examiner [redacted]

REQUIRED TEXT: *Quantitative-Qualitative Friction-Ridge Analysis: An Introduction to Basic and Advanced Ridgeology* by David Ashbaugh, CRC Press 1999, ISBN: 0849370078
COURSE OBJECTIVES: This course is intended to give students insight into the science of fingerprinting. Upon completion of this course, students should be have an understanding in rolling fingerprints, photographing fingerprints, recovering latent print, comparing prints, classifying prints, and ACE-V methodology.
DROP DATE: The last day to drop a class without academic penalty is October 1, 2008.
COURSE COMMUNICATIONS: Communication with the students will be primarily during class lectures. If there are any changes that arise in the syllabus or class schedule between class meetings, each student will be notified of the change via USM email. Therefore, it is given that each student is expected to have their USM email address activated for this purpose.
COURSE REQUIREMENTS & GRADING POLICY:

1. Three major exams	25% each (75% total)
2. Quizzes (Minimum of 6 with 1 drop grade)	15% total
3. Courtroom Exhibit	5%
4. Class Attendance and participation/Article	5%

GRADING SCALE:
A= 89.5-100%
B= 79.5-89.4%
C= 69.5-79.4%
D= 59.5-69.4%
F= 59.4% and below
COURSE Topics:
Introduction to Concepts
Pattern Identification
Classifying Prints
Rolling Prints
Recovering latent prints
Print Comparison
Methodology
Friction Skin Morphology
Analysis, Comparison, Evaluation, and Verification (ACE-V)
OFFICE HOURS: 9 - 11 a.m., Monday & Wednesday
ADA STATEMENT: If a student has a disability that qualifies under the Americans with Disabilities Act (ADA) and requires accommodations, he/ she should contact the Office for Disability Accommodations (ODA) for appropriate policies and procedures. Disabilities covered by ADA may include learning, psychiatric, physical disabilities, or chronic health disorders. Students can contact [redacted] if they are not certain whether a medical condition may qualify. [redacted] or [redacted], fax-[redacted] Students with hearing impairments can contact [redacted] using the [redacted] Relay Service at [redacted] or email [redacted] at [redacted]
ACADEMIC HONESTY: ([redacted] Undergraduate Bulletin, 2007-2008, p. 88) When cheating is discovered, the faculty member may give the student an F on the work involved or in the course. If further disciplinary action is deemed appropriate, the student should be reported to the dean of students. In addition to being a violation of academic honesty, cheating violates the Code of Student Conduct and may be grounds for probation, suspension, or expulsion.
Students on disciplinary suspension may not enroll in any courses offered by [redacted]

APPENDIX B

CLASS DESCRIPTION OF PRACTITIONER COURSE

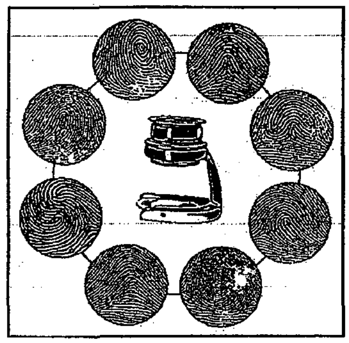
Introduction to the Science of Friction Ridge Examination

Presented by Ron Smith and Associates, Inc., and the International Association for Identification

Instructor: Mike Campbell, CSCSA

Course Description

5 Day Course



The knowledge of how to evaluate, compare and identify friction skin is accomplished through many hours of training and experience that involves independent study and one on one mentoring by an expert. This course is designed to start that process through a series of lectures, practical exercises and drills that are specifically designed to increase the student's knowledge and foster confidence in the usefulness of the science and their ability to use it. Many different facets of friction skin examination will be explored and the challenges associated with the science will be discussed in detail. Each participant will understand the principles underlying the science and as a result, they should have a practical, functional knowledge of how to examine friction skin upon completion of the course. The course starts by teaching the "language" of friction skin examination and pattern recognition. Then the student will learn how to use all three "levels of detail" and apply ACE-V. methodology as the basis for the examination process.

At the completion of this 40 hour course the student will be able to understand the following:

- Understand the difference between the *"Classification"* of fingerprints and the *"Identification"* of fingerprints
- Understand the three types of *"classification systems"* in use today – Henry, NCIC and IAFIS
- Understand, interpret and recognize the three basic fingerprint patterns and their eight sub-sets – *arches, loops* and *whorls*
- Understand the basic principles behind the use of fingerprints as a means of positive human identification – *Uniqueness* and *Persistence*.
- Understand the three *"Levels of Detail"* used today in fingerprint examination – fingerprint patterns with their ridge flows, ridge events or points of identification and the individual ridge units made up of pores and the sides of the ridges.
- Understand A.C.E. – V. methodology used by experts to compare and *individualize* or *eliminate* fingerprints
- Understand the concepts for *"prints of value"*
- Understand the use of *"Point Standards"* in some countries and by some prosecutors
- Understand the various concepts related to the *"verification"* process of ACE – V.
- Understand that absolutely no decision is reported without verification by another expert
- Understand the Daubert decision as it relates to fingerprint examination
- Understand what an *"AFIS computer system"* does and how it is used in various ways to assist fingerprint examiners as well as how *"Live Scan"* technology impacts this process today

At the completion of the course the student will be able to perform the following:

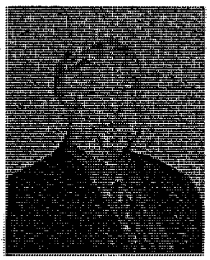
- Understand and be able to use current terminology for the fingerprint science (the language of the science)
- Fully classify fingerprint cards using the NCIC and IAFIS codes and understand the Henry classification system as it is used today

- Accurately determine the proper pattern type of a fingerprint, especially for use with an AFIS
- Begin to properly determine the "Value" or suitability of a fingerprint for comparison
- Understand all three levels of detail and begin to accurately compare friction skin using them
- Properly use ACE – V. methodology to make decisions during the examination process with real friction skin of various types, tips, joints, etc....
- Understand the significance of recording "*good*" fingerprints at the time of booking or capture

COURSE TARGET AUDIENCE:

This course has been designed with many different groups in mind and is suited for law enforcement personnel and students who are new to forensics as well as law enforcement personnel and students who are already familiar with forensic identification matters including experienced 10 Print and Latent Print examiners who are already conducting examinations or are being trained to do so. Because of the scope of material covered, this course is beneficial for all but the seasoned examiners and it can serve as an excellent introduction into the science for those of other disciplines, particularly crime scene personnel. Law enforcement personnel will be able to return to work and immediately use this training to continue their development as examiners. Students would be able to apply for jobs that require such training as a requirement. Other professionals involved in both the academic and judicial systems would also benefit as they would receive a broad overview of the science without having to put it to practical use.

ABOUT YOUR INSTRUCTOR



Michael J. Campbell
Training Coordinator, RS & A, Inc.
Pewaukee, WI

Your instructor, retired Captain of Police Mike Campbell is a 28-year veteran of the City of Milwaukee Police Department, recently retiring as the Commanding Officer of their Identification Division. After his retirement Mike accepted a position as the Training Coordinator for Ron Smith and Associates, Inc. a forensic training and consulting company based in Meridian, MS.

In addition to his work related practical experience coming from more than 20 years as a crime scene and fingerprint identification specialist with the department, Mike has been blessed to receive more than 1,200 hours of training in the fields of forensic identification, crime scene processing, evidence photography and crime scene and personnel management.

During his time with the department he provided much of the training for the department in these areas. In addition Mike has taught well over 250 courses to several thousand students in 25 states and Canada and has lectured dozens of times on these matters for various forensic groups and conferences.

Presently Mike is a member of the FBI sponsored Scientific Working Group on Friction Skin Analysis, Study and Technology (SWGFAST) group and he currently serves on the International Association of Chief's of Police Forensic Committee, the Board of Directors for the International Association for Identification and is the past board chair and president of the Wisconsin Association for Identification. He holds active membership in the Canadian Identification Society and the Midwest Association of Forensic Scientists and serves on other various boards and panels.

GENERAL COURSE INFORMATION

Daily Schedule: This course will begin at 8:00 a.m. on the 1st day of the workshop. Classes will begin each day promptly at 8:30 a.m. and conclude by 4:30 p.m. On the last day, the class should conclude no later than 4:30 p.m.

Class attire should be casual and comfortable.

This training seminar has been approved for 40 hours of Continuing Education Credit required for I.A.I. Certification and Re-certification

Certificates of attendance, authorized by the International Association for Identification, will be awarded to each student successfully completing the seminar.

TUITION: See course registration page

COURSE CALENDAR

Click on the date that interests you for more information about location and registration

WAYS TO ENROLL

Online:
Visit the registration link for the scheduled date and location in which you are interested and fill out the online registration form associated with this course.

By FAX:
Complete all the information on the registration form, print it out and fax it to us at 601-626-1122.

By Mail:
Complete all the information on the registration form, print it out and mail it to us at:

Ron Smith & Associates, Inc.
Attention: Training Division
P.O. Box 670
Collinsville, Mississippi 39325

By Phone:
Call us toll free at 1-866–TEAM RSA (832-6772) and register directly with one of our Training Division staff members.

PAYMENT OPTIONS:
By Check:
Checks are to be made payable to "Ron Smith & Associates, Inc." All registrants should forward a department check, personal check or purchase order, along with a copy of their completed registration form to Ron Smith & Associates, Inc.

By Credit Card:
To pay by credit card, please contact Ron Smith & Associates, Inc. and speak with one of our representatives. Call toll free at 1-866–TEAM RSA (1-866-832-6772)

APPENDIX C

IRB APPROVAL FORM

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

Institutional Review Board

118 College Drive #5147
Hattiesburg, MS 39406-0001
Tel: 601.266.6820
Fax: 601.266.5509
www.usm.edu/irb

HUMAN SUBJECTS PROTECTION REVIEW COMMITTEE
NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Human Subjects Protection Review Committee in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: **28080701**
PROJECT TITLE: **Form Blindness Testing: A Predictor in Assessing the Ability to Train the Latent Print Examiner**
PROPOSED PROJECT DATES: **08/18/08 to 08/17/09**
PROJECT TYPE: **Dissertation or Thesis**
PRINCIPAL INVESTIGATORS: **Dean J. Bertram**
COLLEGE/DIVISION: **College of Education & Psychology**
DEPARTMENT: **Adult Education**
FUNDING AGENCY: **N/A**
HSPRC COMMITTEE ACTION: **Expedited Review Approval**
PERIOD OF APPROVAL: **11/24/08 to 11/23/09**

Lawrence A. Hosman
Lawrence A. Hosman, Ph.D.
HSPRC Chair

12-02-08
Date

APPENDIX D

DEPARTMENTAL CHAIR LETTER OF RESEARCH APPROVAL

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

MEMORANDUM

TO: Dr. Lawrence Hosman, Chair
USM Institutional Review Board

FROM: Lisa S. Nored, Chair LSN
Department of Administration of Justice

RE: Use of Archival Data by Dean Bertram

DATE: August 5, 2008

Please accept this memorandum in support of the request by Dean Bertram to utilize archival data contained in records from Forensic Science 340. It is my understanding that this data will be utilized for purposes of his dissertation through the Department of Adult Education. Departmental support is conditioned on strict confidentiality of student identity. Any and all results may only be reported in summary form. If you require further information, please feel free to contact me.

APPENDIX E

FBI LETTER OF RESEARCH APPROVAL

U.S. Department of Justice

Federal Bureau of Investigation

Clarksburg, WV 26306

September 5, 2008

Dean J. Bertram
University of Southern Mississippi
Hattiesburg, MS 39406

Mr. Bertram has asked permission to use the Federal Bureau of Investigation's fingerprint comparison test that contains 99 looping patterns used to train an examiner's eye to catch the similarities and dis-similarities in very similar pattern types. Let it be known, that he has such permission and there should be no issue with using that test that has been used over the past 25 years as a training tool.

Phillip David Morgan
Federal Bureau of Investigation
Criminal Justice Information Services Division
Biometric Services Section
(304)-625-5745

APPENDIX F

PIMA COUNTY PATTERN RECOGNITION TEST USE PERMISSION

Pima County Sheriff's Department

1750 E. Benson Highway • Tucson, AZ 85714-1758
Phone 520-741-4600 • Facsimile 520-741-4622
www.pimasheriff.org

Clarence W. Dupnik
Sheriff

Keeping the Peace and Serving the Community Since 1865

To Whom It May Concern:

The pattern recognition test is used to test an individual's ability to recognize basic pattern forms. The student is timed and graded on the number correct versus the number attempted. The Pima County Sheriff's Department Forensic Unit uses this test as a preliminary test prior to hiring an individual for the job of Fingerprint Technician trainee or Latent Print Examiner trainee. The Pima County Sheriff's Department has been using this test for nearly 20 years and grants Dean Bertram at the University of Southern Mississippi permission to use this assessment tool in his dissertation.

Kathleen Bright-Birnbaum

Kathleen Bright-Birnbaum, CLPE

APPENDIX G

LETTER OF APPROVAL OF FORM BLINDNESS TEST USE

JOHN PAUL OSBORN

FORENSIC DOCUMENT EXAMINATION

2424 MORRIS AVENUE, SUITE 203

UNION, NEW JERSEY 07083

TELEPHONE 908-206-9501 FAX 908-206-9503

A FOUR GENERATION FAMILY PRACTICE

CELL 908-337-0803

E-MAIL JPOSBORN@AOL.COM

WEBSITE WWW.OSBORNANDSON.COM

ALBERT S. OSBORN (1858-1946)

ALBERT D. OSBORN (1896-1972)

RUSSELL D. OSBORN (1936-1994)

PAUL A. OSBORN (1931-2007)

MEMBER:

AMERICAN ACADEMY OF FORENSIC SCIENCES

AMERICAN SOCIETY OF QUESTIONED DOCUMENT EXAMINERS

AMERICAN SOCIETY OF TESTING AND MATERIALS

NORTHEASTERN ASSOCIATION OF FORENSIC SCIENTISTS

AMERICAN SOCIETY FOR TESTING AND MATERIALS

CERTIFICATION:

AMERICAN BOARD OF FORENSIC DOCUMENT EXAMINERS

August 11, 2008

Dean J. Bertram
Forensic Science Instructor
The University Of Southern Mississippi

RE: Form Blindness Test

Dear Mr. Bertram:

Thank you for your phone call today concerning the "Form Blindness Test" appearing in the book "Questioned Documents" by Albert Sherman Osborn (ASO). I am a forensic document examiner ("examiner of questioned documents") and operate the practice started by ASO, who was my great grandfather.

I am unaware of any rights I may have or hold with respect to ASO's books, however to the extent that it is appropriate I would certainly grant you any permission necessary to conduct research and write citing this test of form recognition. I am, currently, the only member of my family practicing in this field.

As I mentioned to you over the phone, while I believe it quite appropriate to test individuals who are entering my field as to their ability to recognize fine differentiations in form, the "Form Blindness Test" may not, necessarily, be the best method to gauge visual acuity with respect to form recognition. Based on your description, the research you are conducting might confirm or refute the usefulness of this test and/or develop a better method to achieve the intended goals of the "Form Blindness Test." I believe such research would be of great value to my field, particularly in terms of modernization of methods to detect the ability to make fine differentiations in form.

Please keep me abreast of your progress.

Very truly yours,

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